ARCHIVES OF OPHTHALMOLOGY.

FURTHER EXPERIMENTS ON THE LYMPH-STREAMS AND LYMPH-CHANNELS OF THE EYE.

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(*With plate.*)

IN this paper it is not proposed to consider the histology of the finer lymph channels, but merely the paths by which the chambers and larger lymph-spaces of the eye communicate with each other and with the parts external to the eye. The literature of the subject is so extensive that to review it at all thoroughly would consume too much valuable space. For *résumés* the reader is referred to the papers of Schick [1] and of Staderini.[2]

My own experiments have been continued, with the interruptions unavoidable in active practice, from 1886 up to the present time. They are not fully completed, but as this completion may have to be indefinitely postponed, I feel justified in publishing such results as have already been obtained.

Methods.

For observing the transportation of pigment granules by the lymph-currents of the living animal, I have injected suspensions of india-ink and of cinnabar in a $\frac{1}{2}$–$\frac{3}{4}$ % sodium chloride solution. The cinnabar has the advantage of being less likely than india-ink to cause marked reaction, but the particles are heavier and less easily transported by the lymph-stream. India-ink, even when thoroughly sterilized, causes, when much is introduced, quite a sharp reaction, but

[1] Schick. *Archiv für Ophthal.*, xxxi., 2.
[2] Staderini. *A. f. O.*, xxx.

it reaches fine channels which I have not found demonstrable with cinnabar. Injections into the vitreous I have made both through a scleral incision and through the puncture of a hypodermic needle alone, with no perceptible difference in the results except that with a free incision the pigment is not carried out of the vitreous so promptly. The scleral incision does away with the theoretical objection that the injection might interfere with natural currents by raising the tension, but, practically, even when the pigment is injected through a hypodermic puncture, so much fluid escapes from the opening immediately on the withdrawal of the needle, that it is evident that this opening is sufficient to draw off any excess of intraocular fluid before the pigment granules can have been influenced perceptibly by the currents of the eye. In injecting pigment into the anterior chamber of the living rabbit, the most satisfactory method is that described by me in 1887.[1] Instead of piercing the cornea an incision is made through the ciliary body into the posterior chamber. Through this the needle or glass canula is passed by way of the pupil into the anterior chamber. By gently lifting the iris, part or all of the aqueous can be evacuated and its place filled with the pigment suspension, which then cannot escape except by the natural outlets; while, if it is injected through a corneal wound, much or nearly all of it escapes at once on the withdrawal of the instrument. In injecting the anterior chamber and its outlets, *post mortem*, I have obtained the most striking results with asphalt chloroform (15 %) and a solution of alkanet in turpentine. In the experiments with ferro-cyanide of potassium and with fluorescein no important departure from the ordinary methods was made. Except where otherwise stated, albino rabbits were used for all experiments.

Experiments on Living Animals with Ferro-Cyanide of Potassium.

As is well known, the method of Memorsky,[2] consisting in the introduction of a solution of potassium ferro-cyanide

[1] GIFFORD. Trans. Internat. Med. Cong., 1887.
[2] MEMORSKY. *A. f. O.*, xi., 2.

into the eye and precipitating it by placing the eye, after enucleation, in a ferric chloride solution, gives in the blue precipitate formed a very delicate test for the presence of the salt in the tissues into which it may have penetrated during life. Knies [1] assuming that, in general, a sharp blue line in an eye thus treated indicated a lymph-stream, used this method for attaining far-reaching conclusions as to the currents in the eye; and his results were largely confirmed and to some extent widened by Weiss [2] and by Ulrich [3]; the latter concluding that the aqueous, in passing from the posterior to the anterior chamber, does not go through the pupil, but traverses the tissues of the iris. Of these experiments, I have made twenty-eight; twenty-four injections of the ferro-cyanide solution into the vitreous; four subcutaneous injections. The results were, in the main, similar to those described by Ulrich; the sharp blue line passing through the iris root, to which he attributes so much importance, was observed in a large proportion of the cases. Why it was not observed or commented upon by Knies and Weiss I cannot understand. I have not, however, found the line to be so constant as one would expect from Ulrich's descriptions. He speaks of obtaining pictures indicating that a part of the stream from the posterior chamber passes through the iris into Fontana's spaces, without entering the anterior chamber at all; meaning by this, I suppose, that he has noticed the blue line taking this course. I have not only seen this, but have seen the line passing from the zonula through the ciliary body into the inner layers of the sclera so far back as not to touch the posterior chamber, nor even the front half of the ciliary body. I have also found the line passing through the iris half-way down toward the pupil. Sometimes there are three or more lines in different parts of the iris, and these, or the single one, may go only part way through the iris either from behind forward, or the reverse; or a line may start from the anterior surface

[1] KNIES. *Virchow's Archiv*, lxii. and lxv., and *Archiv für. Augen- und Ohrenheilk.*, vii.

[2] WEISS. *A. f. O.*, xxv., 2.

[3] ULRICH. *A. f. O.*, xxvi., 3, and *A. f. Augenheilk.*, xii.

and taking a curved course pass first toward the posterior surface, but turn and, without reaching this, pass out at the anterior surface again. Such variations occur without any easily ascertainable cause. Sometimes, in eyes treated as nearly alike as possible, there will be very decided differences in the lines, and the same is true of the corneal and scleral lines of Knies. In the central canal of the opticus, along the vessels, I have occasionally found a blue coloration extending out into the orbital tissue, but this only exceptionally. In the few experiments in which I have injected the ferro-cyanide solution subcutaneously, the eyes have twice presented the appearance described by Ulrich. The blue line in the iris was nowhere sharp and distinct, but there was a diffuse blueness in the iris root. In many cuts, however, the appearance was not even that of a diffuse line passing clear through the iris, but gave the impression of the solution having been soaked up from the aqueous by the anterior surface, as the blue began at this surface and extended not more than half-way through toward the hind surface, becoming fainter the greater the distance from the fore surface. There was also, after these subcutaneous injections, an occasional blue line farther down in the iris toward the pupil. Regarding the blue in the cornea proper, both after the vitreous and the subcutaneous injections, the evidence was decidedly in favor of the solution having penetrated it, if at all, not directly from the aqueous through Descemet's membrane, but indirectly by way of the tissues of the sclero-corneal junction. When the ferro-cyanide solution was not left long in the eye or circulatory system before the animal's death, the cornea frequently had no blue in it except near the periphery and in the intercellular lines of Descemet's epithelium. The longer the experiment was continued the greater the tendency for the blue to extend clear across the cornea from border to border. I would not assert on the strength of this that none of the ferro-cyanide diffuses through Descemet's membrane from the aqueous into the cornea, but simply that this does not occur, if at all, so rapidly as the diffusion from the periphery.

But although my results in most respects agree with those

of Knies, Weiss and Ulrich, in my interpretation of them I am obliged to differ radically from these writers. In fact my experiments on dead animals have convinced me that the ferro-cyanide method, as used by them, is practically useless in investigating the normal lymph-stream, and for this reason I spare the reader a more minute description of the results obtained by it in the live animal.

Injections of Ferro-Cyanide into the Vitreous of Dead Rabbits.

Stilling[1] mentions a verbal communication from Weiss to the effect that results similar to those obtained by him in living animals had also been obtained in dead eyes. Aside from this, the only reference that I know to such experiments is made by Ulrich in a footnote to his last paper. He here mentions having tried injections of ferro-cyanide into the vitreous of dead pigs' eyes. He speaks of the results as radically different from those obtained in the living animal, but his descriptions would seem to indicate a difference not so radical after all. I have made twelve experiments of the kind. The rabbit having been chloroformed till the last sign of life had been gone for from five to ten minutes, a few drops of the ferro-cyanide solution were injected into the vitreous, either simply by puncturing with a hypodermic needle or through a broad scleral incision, and the whole animal put into an oven, kept at blood heat for an hour, the eyes then being enucleated and hardened in tincture of ferric chloride diluted with alcohol. In six cases Ulrich's and Knies' lines in the iris and cornea were found as well marked as in any case where the injection had been made *ante mortem*. In one case where barely enough ferro-cyanide solution had been injected with a hypodermic to raise the tension of the dead eye to near the normal, and the needle, instead of being withdrawn at once had been pushed through the sclera on the opposite side and left in position till the eye was hardened, the blue lines were brighter and more

[1] STILLING. *A. f. Augenheilk.*, xvi.

marked than I have ever obtained them in experiments on a live animal. To meet the objection of Ulrich that even in the dead eye the pressure in the vitreous might force the ferro-cyanide out through the iris root, several eyes were opened so widely by scleral incisions of more than one centimetre in length that the question of pressure could be entirely eliminated. Ferro-cyanide was then injected freely, most of it flowing back as fast as it was introduced. In the majority of these eyes, also, the lines of Knies and of Ulrich were found. In one eye about one third of the vitreous was scooped out through an incision about one *cm* long and replaced by ferro-cyanide solution. This eye also showed a well-marked Ulrich's line. In these eyes the retina and sclera were often blue throughout, except near the corneal border, instead of showing the narrow lines generally seen after injection into the living eye; the central canal of the opticus, also, contained a blue precipitate more often than in the experiments made during life.

My conclusion therefore is that while the blue lines obtained by the ferro-cyanide method are at first sight very striking, and may, to some extent, be influenced by vital processes, there is no evidence to show that they really follow the paths of normal lymph-streams. Aside from the fact that those upon which most stress have been laid occur equally well in the dead eye, their occurrence in the living eye is subject to such variation and is so entirely independent of any histological basis as to throw most serious doubts on their physiological importance. The believers in the value of the method have themselves mentioned this lack of any histological basis for the lines, without having laid sufficient stress upon it. In many parts of the eye these blue lines appear under conditions rendering it manifestly impossible that they indicate the path of the lymph-streams. A line is sometimes seen passing from the vitreous obliquely into the lens and then back into the vitreous again; or from the dural sheath down into the optic nerve and then out again. The scleral line of Knies sometimes leaves the eye and passes obliquely through the recti muscles or orbital tissue, in a sharp straight line which it would be absurd to

suppose a lymph-stream to follow. On the other hand, it is equally unreasonable to suppose that the ferro-cyanide would *diffuse* through the tissues in such sharply defined lines as are often seen, without any histological basis. A completely satisfactory explanation of the origin of all these lines is difficult to give. Sometimes, though only occasionally, they occur in the neighborhood of what other experiments show to be lymph-channels, as, for instance, along the blood-vessels passing through the sclera, sclero-corneal junction, and optic nerve. Whether the ferro-cyanide has reached these channels by simple diffusion or has been carried thither by some current, is impossible to say. *In most cases, however, these lines undoubtedly represent the boundary between the area into which the ferro-cyanide has diffused and that which is still free from it.* Along such a boundary there is an uncommonly strong precipitation of the blue salt, because the instant the solution of ferric chloride into which the eye is put penetrates to such a line, precipitation takes place, thus producing a line of liquid containing less of the salts in solution, and toward such a line the salts from both sides tend to diffuse and be in turn precipitated, the result being the accumulation of the blue precipitate in a more or less distinct line. This can be demonstrated by injecting several drops of a solution of ferro-cyanide into the centre of a piece of liver one or two inches in diameter and, after some minutes, hardening in tincture of ferric chloride diluted with alcohol. On cutting through such a piece, I have found the tissue into which no ferro-cyanide had penetrated marked off from the more internal portions containing it by a sharp blue line precisely like those found in the eye. The rather constant presence of a blue precipitate in the iris root, in many cases where the boundary line seems to fall elsewhere, is probably due to the proximity of this structure to Fontana's spaces, through which all the aqueous has to pass and with which its meshes freely communicate. Diffusible salts also undoubtedly pass into the iris to some extent from the posterior chamber, and where a salt is injected subcutaneously some of it probably diffuses through the walls of the vessels which abound in the iris root.

Experiments with Subcutaneous Injections of Fluorescein.

Convinced by the results just mentioned of the small value of the use of diffusible substances in this work, and in view of the results of Ehrenthal,[1] who has obtained all the characteristic phenomena of Ulrich's line by injecting a weak solution of fluorescein under low pressure into the carotid of the dead rabbit, I have made only five such experiments. My results have corresponded most nearly with those of Ulrich. The fluorescent line which appears in the anterior chamber about ten minutes after injecting 3–5 cc. of a 20 % solution of uranin (soluble ammonia salt of fluorescein), under the skin, unquestionably takes its origin in the upper periphery of the chamber. When the eye is rotated, the line always changes, though sometimes a little slowly, so as to remain vertical; it is not, in other words, bound up with any particular part of the iris periphery. In my first two or three experiments on albino rabbits, I thought I could detect the yellow coloration of the whole iris periphery which Ulrich describes as evidence in favor of his theory of a stream through the iris root; but upon the most careful examination in my last experiment with an albino rabbit, I felt uncertain whether the yellow was really in the iris root, or in the almost transparent edge of the limbus corneæ, which in all experiments is one of the earliest tissues to show a yellow color. Granting, however, that it is in the iris, I see no reason for dismissing so scornfully, as Ulrich does, the explanation of Schick, that the color is due to the fluorescent fluid in the posterior chamber shining through the translucent albino iris. In any event, it is reasonable to suppose that enough fluorescein might diffuse from the posterior chamber through the iris root to appear on the anterior surface, without this constituting any proof that the lymph-stream takes this course. I regard Ehrenthal's explanation of Ulrich's line as the most satisfactory. He considers it due to the force of gravity acting upon the fluorescein which diffuses into the periphery of the anterior chamber from the plexus of blood-vessels in this

[1] EHRENTHAL. *Inaug. Diss.*, Königsberg, 1887.

vicinity; and as he has shown that the line appears equally well whether the animal be dead or alive, few will be inclined to believe that the normal lymph-stream has much to do with it.

Injections of Fluorescein into the Living Vitreous.

In view of the foregoing, I should not have busied myself further with fluorescein but for the statement of Pflüger,[1] partially confirmed by Schoeler and Uthoff,[2] that fluorescein injected into the vitreous does not reappear in the aqueous. This appeared to me very surprising, in view of the readiness with which I had observed ferro-cyanide diffuse from the vitreous into the aqueous. To test the question, therefore, the following experiment was made: September 17, 1890, small black rabbit, 3–4 gtt. of 10 % solution of uranin injected into each vitreous back of and below the centre. On withdrawing the needle about the same quantity of fluid flowed out under the conjunctiva. After ¾–1 hour, vitreous strongly fluorescent, but no fluorescence for certain in the aqueous. On slight struggling of the rabbit, however, clouds of fluorescence could be seen to burst into the anterior chamber through the pupil in each eye. After 10–15 mins. these clouds diffused through the aqueous which, even then, could not be distinctly seen to be fluorescent, in the intact eye, but on making a paracentesis, after washing the cornea and conjunctival sac carefully, the escaping aqueous was seen to be strongly fluorescent. After some weeks the same experiment was tried on the same rabbit, with results proving equally clearly the passage (by diffusion or otherwise) of fluorescein from the vitreous to the aqueous.

Introduction of Small Quantities of Pigment into the Chambers of the Eye and into the Cranial Cavity, in Live Rabbits.

Although I am convinced that this method gives the most trustworthy results, as to the paths and directions of the

[1] Pflüger. *Zehender's Monatsblätter*, xx.
[2] Schoeler and Uthoff. *Nagel's Jahresbericht*, xiii.

lymph-currents, continued experience with it has taught me that it has more decided limitations than I at first supposed. At first I was inclined to believe, wherever considerable pigment was carried into lymph-channels, apparently without the aid of leucocytes (*i. e.*, without pigmented leucocytes being present along the track), that it must have been transported by some regular stream. I have found, however, that in some channels, especially in the finer ones, the pigment finds its way equally well in precisely opposite directions. In the lymphatics surrounding the small blood-vessels of the optic nerve, for instance, india-ink passes regularly from the large canal of the retinal vessels toward the periphery of the nerve and into the intervaginal space; but it also passes equally well in the opposite direction, from the intervaginal space through the pial sheath, along the small vessels toward the central canal; and this apparently without the intervention of leucocytes, though in this latter direction I have not observed it to pass more than half-way from the periphery to the centre of the nerve. The same can be observed to some extent in the lymphatics surrounding the venæ vorticosæ; here pigment passes from the perichoroidal space out to the space of Tenon, but also, for a short distance at least, from the latter in toward the choroid. Even in the central canal of the optic nerve, where the evidence of a stream passing out along the vessels is most conclusive, I have observed small quantities of pigment passing from the intervaginal space for a short distance in toward the vitreous, though in nothing like the quantity which at the same time is carried out from the intervaginal space into the orbital tissue outside the nerve. These facts tend to confirm the judgment of Leber as to the caution with which conclusions must be drawn from the presence of pigment in any tissue, as to the method of its transport thither. As I have mentioned in my first paper, the absence of leucocytes is no proof that they have not been instrumental in carrying pigment to any point where it may be found, since, for anything we positively know to the contrary, they might carry the pigment granules for a certain distance, and then give them up, without leaving any

trace of their action. Conversely, of course, pigment might be carried for some distance by a current, and then be taken up by leucocytes, so as to appear to have been transported by them. But while the first of these suppositions may possibly explain the passage of pigment against the stream in the larger channels, in the smaller ones it is more probable that there is either no regular current, or so slight a one that it is liable to be stopped or even reversed by the slight variations of pressure which may accompany the movements of the eyeball; so that pigment finds its way all through these finer channels, as it would through the interstices of a loose sponge, if the latter were gently moved for some time in a fluid containing pigment in suspension. In certain channels, as in those of the central canal of the opticus, so much more pigment is carried in one direction than in the other that we are justified in saying, from this evidence alone, that a stream flows in a certain direction; but even where it does not decide as to the existence or direction of a stream, the pigment method is a valuable supplement to injections under low pressure in the dead animal, as the granules whether carried by leucocytes or not point out the open channels everywhere, without leaving room for the objection to which injections in the dead animal are always open, namely, the possibility of the formation of false passages.

I.

INTRODUCTION OF PIGMENT INTO THE CRANIAL CAVITY.

My latest experiments under this head have developed nothing new as to the passage of pigment from the cranial cavity down to the eye, which almost invariably occurs; but they have led me to modify considerably my views as to the lymph-current between the intervaginal and perichoroidal spaces. Although in my previous experiments,[1] I had not observed pigment pass from the intervaginal to the perichoroidal space, I had seen anthrax bacilli and blood do this to some extent, and had concluded that this was the

[1] GIFFORD. *A. f. Augenheilk.*, xvi., and these ARCHIVES, xv., p. 153.

normal course of the lymph-stream. Deutschmann[1] also subscribes to this view as the result of a single experiment in which the pigment passed from the cranial cavity forward through the perichoroidal space to the venæ vorticosæ and along these vessels out to Tenon's space. My negative results with pigment I explained by assuming that the pigment came down from the cranial cavity in such quantities that the narrow entrance from the intervaginal to the perichoroidal space was blocked by it; but I am now convinced that this explanation is incorrect. I have had the same negative results when the quantity of pigment brought down from the cranial cavity was so small as to preclude the idea of any blocking of the channels; and even in the cases where, from microscopic appearances a blockade might be thought of, I have observed the pigment passing from the main mass along the small vessels into the nerve and through the dural sheath to Tenon's space, but not into the perichoroidal space. Considering then the overwhelming majority of negative results obtained by Quincke,[2] Zellweger,[3] Deutschmann, and myself over the single positive result of Deutschmann and my own three positive results, it must be admitted that while there are evidently open channels between the intervaginal and perichoroidal spaces, the evidence is decidedly against the existence, as a rule, of any stream in them from behind forward; rather, if any, in the contrary direction, when we remember that the pressure in the perichoroidal space is probably very nearly the same as that in the vitreous and hence considerably higher than that in the intracranial and intravaginal spaces.

The main outlet for the pigment in the intervaginal space leads into the orbital tissues around the central retinal vessels. The pigment also penetrates the dural sheath along the smaller blood-vessels, and along the surface of the sheath, passes forward into Tenon's space as far as the equator of the eye. The pigment is taken up by the whole inner sur-

[1] Deutschmann. Ueber d. Ophthalmia Migratoria. Hamburg, 1889, p. 25.

[2] Quincke, *Reichert and Dubois-Reymond's Archiv*, 1872.

[3] Zellweger. *Inaug. Diss.*, Zürich, 1887.

face of the dural sheath of the nerve, but except along penetrating vessels, I have not seen it pass clear through the sheath into the supravaginal space. As previously mentioned, the pigment also passes from the intervaginal space through the pial sheath along the small blood-vessels toward the centre of the nerve. Finally, at the point where the central retinal vessels leave the nerve, although there can be no doubt that the main current is out into the orbit, a small amount of pigment finds its way up for some distance around the vessels toward the vitreous, whether through the agency of leucocytes or an occasional reversal of the current, I am unable to say. In the orbital tissue below the nerve, there is no such strong current toward the cranial cavity as I supposed when I wrote my first paper. The pigment passes partly back along the vessels to the end of the orbit, but also to some extent forward and downward. That there is any main current down toward the floor of the orbit as Deutschmann believes, I doubt. My impression is that there is no decided stream, but that through the motions of the eye and the body, the pigment becomes pretty evenly disseminated throughout the loose tissues of the orbit, with, perhaps, some tendency downward from the force of gravity.

II.

INTRODUCTION OF PIGMENT INTO TENON'S SPACE.

Early in the course of these experiments, a number of results seemed to show that in Tenon's space and the subconjunctival tissue generally, there was a decided stream backward; but a continuation of the experiments has shown me that, in the rabbit, there is no proof of a decided stream in either direction, while in man such evidence as is available points rather to a movement of the subconjunctival lymph toward the cornea. India-ink introduced under the rabbit's conjunctiva passes backward and forward with apparently equal facility; while, in man the blood from slight hemorrhages near the retrotarsal folds moves with remarkable regularity toward the cornea, occasionally passing into

the transparent corneal tissue for fully a millimetre from the limbus. Whether the blood would pass equally readily in the opposite direction is a point worth studying, which at present I cannot decide.

III.

INTRODUCTION OF PIGMENT AND OF ANTHRAX BACILLI INTO THE VITREOUS.

Regarding the results of introducing anthrax bacilli into the vitreous, I have little to add to what I have already published. The bacilli pass regularly out through the central canal of the opticus and into the various channels connecting with it, as previously described. I have never seen them pass clear forward around the lens into the posterior chamber, though in one case they were observed more than halfway through the zonula. Where pigment was introduced into the vitreous (as was done in 35 cases), in all cases except one, where an extensive detachment of the retina occurred, part of the pigment was carried out into the orbit through the central canal of the opticus and into the channels connecting with it, as in the case of the anthrax bacilli.[1] In one case, in which the rabbit was killed about thirty days after the injection, an unusually large quantity of india-ink had passed along the small vessels branching off from the central retinal vessels to the choroid, so that the whole perichoroidal space, as far forward as the ciliary processes, was

[1] From Ulrich's last article one would infer that it is impossible to introduce india-ink into the vitreous without causing so much reaction as to arouse the suspicion that this passage through the opticus is due to a partial blocking of the paths leading forward around the lens, rather than to a natural lymph-stream through the opticus. I should judge from this that Ulrich must have had unusually bad luck with his vitreous injections. I have many times injected one or two drops of a sepia suspension into the vitreous with either no perceptible reaction following, or with so slight and so transient a one that it would be hypercritical to consider that it affected the result. In these cases, the ophthalmoscope often showed the pigment beginning to collect upon the papilla several days after every trace of reaction had disappeared, and continuing to collect for many days thereafter. The microscope, also, often showed the pigment passing through the nerve without any sign of a blocking of the anterior outlets.

full of free pigment. From the perichoroidal space, the pigment also passed along the venæ vorticosæ to the space of Tenon. In two other cases also, in which, after a detachment of the retina, the pigment penetrated directly from the vitreous through the wound into the perichoroidal space, this passage, along the venæ vorticosæ and also along the vessels penetrating the eye at its posterior pole, was observed. In these two cases, the pigment in the perichoroidal space passed forward to the ciliary processes and backward for a short distance into the intervaginal space. In both, the rabbit had been allowed to live four or five weeks after the injection into the vitreous. From the perichoroid and from the lymphatics around the penetrating vessels, the pigment passes everywhere into the neighboring scleral tissue, whether with or without the aid of leucocytes could not be determined with certainty. Though pigmented leucocytes were present here and there in most cases, in the one case where the pigment reached the perichoroid from the vitreous along the small vessels near the opticus, they were entirely absent from the perichoroidal space, and, whether from a mere coincidence or not, little or no penetration from this space, or from the perivascular lymphatics, into the scleral tissue could be observed.

In all cases some pigment was found remaining in the vitreous, mostly in clumps on the surface of the retina, either free or in leucocytes. Where it was free, no tendency to penetrate into the retina was evident; but where any considerable quantity of the pigmented leucocytes were collected, some of them could generally be seen penetrating into the retina. In cases where a thick layer of free pigment rests in the hollows of the ora serrata, the epithelial cells occasionally seem to take up a few granules and pass them through into the underlying tissue. In only two cases has more than a small amount of pigment reached the space between the retina proper and its epithelial layer. In one of these the pigment was carried in by leucocytes through the inner layers of the retina, just at the commencement of the ora serrata, spreading from here in the space outside the rods and cones, a considerable distance laterally, and back-

ward to the equator of the eye, much of it being taken into the substance of the cells of the retinal epithelium. From this intraretinal space pigmented leucocytes penetrated the retina proper at various points, but none at all passed through the epithelium into the choroid. Anteriorly the pigment was everywhere stopped short at the commencement of the *pars ciliaris*. In the other case an optic neurectomy had been performed some time previously, but the eye was otherwise perfectly normal. The pigment passed out through the optic nerve, as in ordinary cases, but along one small vessel, branching off from the main ones in the central canal, a considerable quantity of pigment, probably borne by leucocytes, entered the intraretinal space and spread out as in the preceding case, except that here at one point one or two pigmented cells were found outside of the epithelium in the choroid. It may be that to get there they had followed along some penetrating blood-vessel, but of this I could not be certain. Of the pigment remaining in the vitreous more was always found at the bottom of the chamber, but I could determine no definite relation to the canal of Cloquet.

Regarding the passage of pigment[1] forward around the lens, in quite a number of cases where only one or two drops of the pigment suspension were injected into the vitreous and the animal was killed no later than five or six days thereafter, no pigment could be seen to have passed through the zonula, while the passage through the optic nerve was well marked. But when the animal was left alive for from one to four weeks there was almost invariably a considerable passage of free pigment (with or without pigmented leucocytes, according to the severity of the reaction following the operation), occasionally only part way through the zonula, but generally clear through into the posterior chamber, and from here through the pupil into the anterior chamber, where part of it was taken up by the anterior iris surface, but the greater part found its way into Fontana's spaces, whence it tended to pass out along the paths to be mentioned later in describ-

[1] The passage of solid pigment particles through the zonula in the normal eye was first described in my paper of 1887, Ulrich having previously failed to observe it except in one eye with an anterior synechia.

ing the results of injections into the anterior chamber. There is always more pigment in the zonula and in the posterior and anterior chambers below than above. In the posterior chamber one generally finds much less pigment than in Fontana's spaces. In some cases, where the latter are quite full of pigment, there is hardly a trace left in the posterior chamber beyond a few granules in or on the epithelial cells lining the hollows between the ciliary processes at the bottom of the chamber. Generally, however, there are traces of pigment here and there on the posterior surface of the iris, clear up to the pupillary margin, and often quite a layer of free pigment apparently caked at the bottom of the chamber, with more or less pigmented leucocytes, according to the extent of the reaction which had followed the operation. When quite a clump of these leucocytes occurs at the bottom of the posterior chamber some of them are often found penetrating into the iris root, not, however, in the direction of the angle of the anterior chamber but passing farther back toward the ciliary body. A thin layer of free pigment commonly seems to be taken into the surface of the epithelial cells at the bottom of the posterior chamber, but I have never seen the slightest tendency for it to pass deeper into the iris either at the root or elsewhere on its posterior surface. Ulrich, in his last paper,[1] while admitting that the iris root fills up with pigment equally as well when the latter is put into the anterior chamber as when it is put into the vitreous, still insists that, in the latter case, the pigment found in the iris root and anterior chamber must, in part at least, have passed through the iris from behind. He is convinced of this for the following reasons (*loc. cit.*, p. 297):

"First, it is difficult to understand why the iris is not just as permeable for such suspension fluids from behind as from

[1] *Archiv f. Augenheilk.*, xx. In this paper, my first article is referred to as if it were simply a repetition of Ulrich's previous work. One can best decide as to the accuracy of this judgment by reading the few lines of Ulrich's which I there quoted. They contain all that he had then written on the posterior lymph-channels, and he published nothing more on the subject for several years thereafter.

before, especially as it is beyond all doubt that the stream of the aqueous, so far as it can be determined by diffusible coloring matters, passes through the iris from behind; and this stream seems well calculated, when strengthened by the reaction following an operation, to carry pigment particles with it. Second in the majority of experiments the amount of pigment found upon the posterior surface of the iris was in a remarkable disproportion to that in the anterior chamber and the iris root. This disproportion was especially noticeable in the right eye of experiment xi. Macroscopically the posterior surface of the iris appeared entirely free from pigment, while the bridge of pigment running squarely through the iris root was, in cross-section, plainly visible to the naked eye. In experiment ix. the disproportion was of a qualitative nature. While the pigment adhering to the posterior surface of the iris was in general enclosed in cells, the anterior surface was fairly black with free pigment. The pigment in Fontana's spaces was also free. Finally I must refer again to the conditions observed in experiment xv. [In all of these experiments referred to india-ink had been injected into the vitreous.] Only at one point of the circumlental space had the pigment penetrated as far forward as the root of the iris, and only at a corresponding point was any pigment found in the iris root or in Fontana's spaces. This must appear incomprehensible if we admit that the pigment had passed into the anterior chamber through the pupil, to say nothing of the fact that the posterior surface of the iris was free from pigment."

It will be observed that the first of the foregoing reasons takes for granted that the posterior surface of the iris is just as permeable as the anterior, and then begs the question as to the reliability of the results obtained by the ferro-cyanide and fluorescein methods. Now, it is perfectly certain that the anterior surface of the iris is much more permeable for solid particles than the posterior; this is evident from the microscopical character of these surfaces and from the fact that as I have mentioned previously free pigment never passes more deeply, if at all, into the posterior surface of the iris than the most superficial portions of the epithelial

cells, while on the anterior surface, and particularly from Fontana's spaces, it passes much deeper. The disproportion between the different amounts of pigment found upon the posterior and anterior surfaces of the iris, which Ulrich regards as striking enough to constitute his second reason, is easily explained by what has just been stated regarding the permeability of these surfaces. The pigment on its way to the pupil passes over the posterior surface, but this is so comparatively smooth that it is not taken up here in anything like the quantity that it is by the crypts of the anterior surface and the meshes communicating with Fontana's spaces. In Ulrich's experiment xi., where he found the posterior surface of the iris macroscopically free from pigment, the microscope showed that it really was not free. Finally, the fact that Ulrich, in experiment xv., found pigment penetrating from the vitreous to the posterior chamber only at one point and found it in the anterior chamber and iris-root only at a corresponding point, would be more striking if he had assured us that this point was not the lowest point of the eye. After injections of pigment into the vitreous, as I have shortly before mentioned, I have always found more pigment at the lowest part of vitreous, posterior and anterior chambers than elsewhere, and several times I have found it only at this lowest part. This is, of course, simply the result of the force of gravity and until assured that in Ulrich's case a similar simple explanation is not sufficient, one cannot be expected to consider the case of especial significance.

IV.

INTRODUCTION OF PIGMENT INTO THE POSTERIOR CHAMBER.

Although I had made experiments of this kind in 1885, the first published results were those of Ulrich. My results differ in no important particular from those obtained by him. In five albino rabbits I made an incision through the ciliary body into the posterior chamber with a narrow cata-

ract knife; through this incision one or two drops of the india-ink suspension were injected into the lower part of the posterior chamber, where it could be plainly seen through the translucent iris. In some experiments, even before the injection was completed, a black line of pigment could be seen passing over the edge of the pupil into the anterior chamber. In others, especially where eserine had been used before the operation, no pigment was seen in the anterior chamber for a short time after the operation, but it always appeared there within a few hours, and in the course of twenty-four hours no pigment, or only a small clump, could be seen with the naked eye in the posterior chamber. The microscopical examination of five of the eyes thus treated showed that most of the pigment which did not pass forward through the pupil within a short time after the operation was taken up by leucocytes. How large a proportion of these latter pass through the pupil it is difficult to say. Some were always found both before and behind the iris, the greatest number always being clumped together in the lower part of the posterior chamber. Here they sometimes remain for several days at least, and perhaps would remain very much longer, or even indefinitely, if the animal were allowed to live. As has already been mentioned in connection with injections into the vitreous, leucocytes containing pigment sometimes pass from this collection at the inferior cul-de-sac of the posterior chamber into the iris root. They also, I think, pass occasionally in the opposite direction through the zonula into the vitreous, but if they do this at all it is to a very limited extent. In the eyes examined I have always found an occasional isolated pigment-holding leucocyte both in the zonula and in the anterior portion of the vitreous, but as in making the incision for the introduction of the pigment it is difficult to avoid opening the vitreous chamber slightly, I have not felt certain whether these leucocytes came from the posterior chamber or from the path of the incision. Aside from this possibility that a few leucocytes may pass through the zonula in a posterior direction, there is no evidence of any flow from the posterior chamber to the vitreous.

V.

INTRODUCTION OF PIGMENT INTO THE ANTERIOR CHAMBER.

In these experiments (to the number of twenty-five) cinnabar was used three times, while in the others an india-ink suspension was injected, generally through the ciliary incision as previously described under "Methods." The results have been partly described in another paper. In certain particulars they agreed with those obtained by all the other investigators who have made similar experiments. These particulars were: (1) the enclosure of more or less of the pigment in a fibrinous clot (into which leucocytes wander and take up much of the pigment) according as more or less of the aqueous is allowed to escape at the operation[1]; (2) the lodgment of considerable quantities of free pigment in the depressions and superficial layers of the iris, whence leucocytes carry it into the deeper layers also; (3) the accumulation of the main bulk of the pigment, whether free or enclosed in cells, in Fontana's spaces; (4) its passage from these spaces into the iris root, inner layers of the sclera, and the ciliary processes. From this point, the testimony diverges. Calberla[2] and Heisrath[3] claim to have found free pigment in the blood-vessels in the neighborhood of the chamber angle. Brugsch,[4] although he found pigment some distance back in the choroid, concluded that there were no open channels leading from the chamber angle; while Morf[5] describes a system of very large lymphatics permeating the sclero-corneal junction and communicating with the anterior chamber.

[1] One can observe the course of pigment in the anterior chamber, with this clot and nearly all the leucocytes eliminated from the experiment, by injecting the pigment into the vitreous and allowing the animal to live for several weeks. The pigment, in such cases, is generally carried forward in small quantities to the anterior chamber; no clot forms there; few or no leucocytes are found in the chamber and no more in the adjacent tissues than are probably normal. Otherwise the final results do not differ essentially from those obtained by bringing the pigment directly into the anterior chamber.

[2] CALBERLA. *Nagel's Jahresbericht*, v.

[3] HEISRATH. *A. f. O.*, xxvi., 1.

[4] BRUGSCH. *A. f. O.*, xxiii., 3.

[5] MORF. *Inaug. Diss.*, Zürich, 1887.

My own conclusions as to the outlets from Fontana's spaces are as follows: Free pigment passes readily into the blood-vessels of the sclero-corneal junction, and from these into the vessels of the choroid and subconjunctival tissue. I have become convinced of this fact almost against my will. From my early experiments on the subject, I was led to believe that while there was a tolerably free outlet through the perivascular lymph-spaces, no pigment penetrated into the blood-vessels proper. Under the influence of this belief I misinterpreted the results of many later experiments. After injections of pigment into the anterior chamber, when the animal has been allowed to live several days, one always finds pigment, not contained in leucocytes, in the tissues surrounding the blood-vessels of the sclero-corneal junction. The pigment which I have found inside the blood-vessels has mostly been deposited on the surface or in the substance of the endothelial cells. Now it is extremely difficult, unless one happens to make a lucky section, to decide with absolute certainty whether a layer of pigment is just within or just outside the thin wall of one of these vessels; so difficult that, seeing that some of the pigment was apparently outside of the vessel wall, I concluded, after much uncertainty, that it all was outside and maintained this belief until a repetition of Heisrath's experiments showed me that the blood-vessels could be injected from the anterior chamber with pigment suspensions under low pressure; and that pigment, which a series of sections showed me to be unquestionably in the lumen of the blood-vessel, looked precisely as it had done in my experiments on living animals, where the pigment had been left to the natural currents. The quantity of pigment found inside the vessels diminishes rather rapidly as the distance from Fontana's spaces increases. I have found small quantities in the walls of the choroidal vessels, just back of the ciliary body and in the subconjunctival vessels for a few *mm* back of the limbus, but not with any certainty farther back; it is possible, however, that some of the pigment which I have found in the perivascular spaces of the venæ vorticosæ and of choroidal vessels as far back as the equator may have come from

within these vessels. Regarding the histology of the communication between the anterior chamber and the blood-vessels, in many sections one sees an apparently solid column of pigment and pigmented leucocytes continuing from Fontana's spaces directly into a blood-vessel, without the slightest sign of an interruption, as if the entire lumen of the blood-vessel were an opening in the wall of these spaces. In other sections vessels are seen running somewhat parallel to these spaces, sending off short diverticula, which communicate with them. Whether or not there are valves to prevent a reflux from the blood-vessels into the chamber I cannot say. Theoretically they are not necessary, as, under normal conditions, the pressure in the chamber is always much higher than that in the veins. The presence of the pigment within the blood-vessels is best demonstrated by injecting into the anterior chamber, through the ciliary incision already described, enough india-ink suspension to fill it one half or three fourths full, the animal being killed twenty-four to forty-eight hours thereafter. The longer the animal is allowed to live the greater the amount of pigment found apparently in the perivascular tissues, and how much of this gets there by passing from Fontana's spaces directly into the perivascular spaces, and how much of it first passes into the blood-vessels and thence penetrates the walls of these into the surrounding tissues, it is difficult to determine.

Since examining some very thin sections from animals recently experimented on, I have come to realize that much if not all of the pigment which I had considered to be outside the blood-vessels is really contained in the very fine prolongations which these vessels of the sclero-corneal junction send off, and which Preiss has described as connecting directly with the lymph-spaces of the cornea. But as I know of no way to distinguish positively between lymph and blood capillaries in an ordinary section, unless the latter happen to contain red blood corpuscles, I prefer to leave the question open.

Beside passing into the blood-vessels, the pigment passes from Fontana's spaces into the lymph-spaces of the iris-root, the ciliary processes, the choroid, the sclera, and the inner-

most layers of the cornea, in the neighborhood of the chamber angle. In passing to the choroid and perichoroidal space the pigment is found in some cases, but not all, to pass on both sides of the ciliary muscle, leaving the main body of the latter free. In the choroid and perichoroidal space I have found pigment, apparently free as well as in cells, as far back as the equator of the eye. The distance to which it penetrates backward varies according to the amount and kind of pigment used and the length of time that the animal is allowed to live after the operation. In some experiments, where cinnabar was used, it did not penetrate as far back even as the beginning of the choroid; this coincides with the results of Morf (who used cinnabar and found it in the choroid in none of his experiments) and is probably accounted for by the greater weight of the particles of cinnabar. There is no accumulation of pigment in the perichoroidal space proper, but its outer wall and the layers of sclera immediately adjoining are often well filled with pigment, at least as far back as the venæ vorticosæ. Along the walls of these veins the pigment passes to the space of Tenon, into which I have not been able to trace it farther than about a millimetre outside of the sclera. As a rule, not more than the inner quarter of the sclera contains pigment (except along vessels), but occasionally it occurs throughout its entire thickness, in the region corresponding to the ciliary processes.

Regarding the passage of pigment into the cornea, I have been unable to understand why other investigators have overlooked it. It is true that no passage into it occurs through the membrane of Descemet, but from Fontana's spaces I have invariably found pigment penetrating for a short distance into the inner layers of the cornea, often only in a single fine line immediately anterior to Descemet's membrane. Pigment is always found in the epithelial cells of Descemet's membrane, located principally in the periphery of each cell. So marked is this arrangement at the periphery of the cells that the appearance with a low magnifying power is as if the pigment were taken up entirely by the interepithelial cement, and Morf actually describes the

pigment as occurring in the lines of this cement. A close examination, however, has always shown me the pigment within the cell protoplasm and the cement lines free or nearly so. In no case has the slightest indication of a passage through the membrane of Descemet been observed. In the iris the pigment, in the deeper layers, mostly appears to be enclosed in leucocytes, and at the iris root these pigment-holding cells sometimes penetrate clear through into the posterior chamber.

VI.

INTRODUCTION OF ANTHRAX BACILLI INTO THE ANTERIOR CHAMBER.

I have made four experiments of this kind, with results as follows: When a few drops of an aqueous suspension of anthrax spores are injected into the anterior chamber of a rabbit, an abundant growth of the bacillus can generally be seen with the naked eye in the course of 24 hours, and at the end of 48–60 hours, the animal is found dead. In some animals, particularly young ones (several animals were inoculated without my examining the eyes microscopically), a rupture of the corneal limbus below is observed. A microscopic examination shows more or less bacilli in all the blood-vessels, as is usual in cases of general anthrax infection. Besides this, the periphery of the anterior chamber and Fontana's spaces are filled with bacilli. Leaving these spaces, they pass back into the ciliary processes (in the loose connective tissues of which they are found in great numbers), and into the perichoroidal space, in which I have not found them farther than about 1 *mm* back of the beginning of the choroid proper. They also pass for a short distance into the cornea, directly in front of the membrane of Descemet. Regarding their passage into the blood-vessels of the sclero-corneal junction and into the lymph-spaces around these vessels, my first three experiments, made while under the misapprehension that there was no direct connection between Fontana's spaces and the blood-vessels, led me to believe

that the bacilli passed only into the perivascular lymph-spaces; but my last experiment, from which I was able to get much thinner sections, plainly showed the bacilli passing in multitudes from Fontana's spaces directly into the blood-vessels. In most points the anthrax experiments form simply a confirmation of the results obtained with india-ink; but with regard to the iris and choroid there is a marked contrast between the two. In the anthrax experiments the tissues of the iris are found entirely free from bacilli, except those contained within the blood-vessels; in the choroid also there are few or no bacilli, except within the blood-vessels, while the perichoroidal space contains many.

These experiments show conclusively, I think, the untenability of Leber's belief that no open channels exist for the outlet of the aqueous. The results of Heisrath would seem to be sufficient proof of the free communication between the anterior chamber and the blood-vessels of the sclero-corneal junction. His experiments, however, consisted mainly in post-mortem injections, and though he also mentions having found pigment in the blood-vessels, after the injection of small quantities into the anterior chamber of the living animal, he devotes but a few lines to this, which seems to me the most important part of his results. I therefore wish to lay particular stress on the fact that, in the living animal, pigment passes readily from the anterior chamber into the blood-vessels of the sclero-corneal junction, thus demonstrating an outlet for the aqueous, beside which others must be of comparative insignificance.[1] The regular pas-

[1] Since the body of this paper was written the paper of Staderini (*loc. cit.*) has appeared, in which the passage of pigment from the anterior chamber into the circumcorneal blood-vessels is again denied. I have therefore gone over my old preparations again and have made new ones from fresh experiments, and can only say that these last sections show the pigment passing from Fontana's spaces into the blood-vessels so plainly that it must be evident to any one with normal vision. Staderini admits finding pigment in the endothelium of the vessels, and that is exactly where one would expect to find it if it had entered the vessels. Unless large quantities of pigment are introduced into the chamber, and kept in, one cannot expect to find it free in the lumen of the vessels, for the current tends to keep that clear; but when the chamber is

sage of pigment to the choroid and perichoroidal space, especially where anthrax bacilli follow the same courses, shows that here, too, are outlets which must carry off a certain small amount of the aqueous. To be sure, the evidence for any decided current in these lymph-channels is very slight. Much of the pigment found in them appears to be free, and the bacilli certainly are so. But, aside from the difficulties in judging between free pigment and that contained in the fine prolongations of cells, the fact is that, as I have mentioned in connection with the posterior part of the eye, in these fine lymph-channels apparently free pigment seems to pass indifferently, in opposite directions. This is probably because, there being no decided current, the fine pigment particles are, by the movements of the eye, gradually disseminated more or less uniformly through the entire network. Nevertheless, there must, on the whole, be some current, however slight, away from the anterior chamber, since the pressure in the subconjunctival tissue is less than that in the chamber, as must also be that in the perichoroidal space, on account of the intervention of the elastic choroid between this space and the vitreous.

In the foregoing I have made no special reference to the canal of Schlemm, for the reason that I consider it fully proven that this canal is only part of the circumcorneal plexus of veins. In the rabbit no part of this plexus is sufficiently separated from the rest to deserve a special name; but by chloroforming one of these animals with the head hanging down, as recommended by Heisrath, and keeping the eye under alcohol for about ten minutes after death, before enucleating, every part of this plexus which could by courtesy be called Schlemm's canal, can be found filled with red blood corpuscles. But while these vessels plainly connect freely with the venous system, it is probable, as Schwalbe

filled with pigment by the method described above, nearly every section shows pigment, free and in leucocytes, in the lumen of the vessels. A single specimen is more convincing than many words, and I shall be glad to send a specimen illustrating this point to any one taking enough interest in the matter to write me about it. Also specimens demonstrating the passage of pigment from the perichoroidal space out along the venæ vorticosæ (around which it has been denied by several writers that any lymph-spaces exist) can be had on demand.

suggests, that in life they contain but little blood, on account of the pressure from the anterior chamber. As a matter of fact, they sometimes are found to contain little or no blood while the neighboring vessels of the limbus are gorged; and their irregular shapes and fine prolongations (especially well shown after leaving pigment in the chamber 24 hours) make it perhaps questionable whether they should be placed in exactly the same category as ordinary veins.

Post-Mortem Injections into the Anterior Chamber.

The injection of india-ink suspension (two experiments) and of asphalt chloroform (two experiments), under the low pressure of 25 to 30 *mm* of mercury, into the anterior chamber of dead rabbits, and one injection of alkanet of turpentine into a dead sheep's eye, confirmed conclusively the results of Schwalbe and of Heisrath, as opposed to Leber, regarding the direct connection between the anterior chamber and the blood-vessels at its periphery. At the same time, they confirm the conclusion at which I had arrived by experiments on the living animal, as to the connection between the anterior chamber and the perichoroidal space, on the one hand, and the corneal lymph-spaces, on the other. From some cause, the injection of the blood-vessels from the chamber does not always succeed, even when very high pressure is used. My first few attempts led to such entirely negative results that I was tempted to conclude that no direct connection existed. With Berlin blue, but one successful injection was made, and that in the eye of a fowl, where, according to Heisrath, the connection seems to be freer than in quadrupeds. But on perfecting my apparatus for regulating the pressure (I have succeeded better with a low than with a high pressure), and on using alkanet of turpentine, asphalt chloroform and india-ink suspensions, such successful injections and constant results were obtained that, as they simply confirmed the results already obtained in the living animal, I contented myself with the few successful experiments just mentioned.

Why other observers have not noticed the connection of the chamber with the lymph-spaces of the cornea and the

choroid it is difficult to say. Heisrath, in the figure accompanying his article, depicts with perfect clearness the passage of Berlin blue into the cornea, just anterior to Descemet's membrane, but makes no mention of it in the text. Both Schwalbe and Heisrath have observed a continuation of the injection mass into the iris root and back toward the ciliary processes, and the former was inclined to consider this one of the inlets to the chamber.[1] I have found this line of the injection mass continued back several millimetres into the perichoroidal space. To observe this continuation, however, one should examine a number of successive sections, as one sometimes meets with several in which it does not appear. The channels here are evidently extremely fine; they have never been injected from behind and as in the case of the blood-vessels, in injecting them from the anterior chamber, I have succeeded better with a low than with a high pressure.

Experiments to Determine the Presence of Lymph-Streams in the Cornea.

Pflüger's (*loc. cit.*) results, obtained by dropping a solution of fluorescein into the conjunctival sac, strongly indicated the existence of quite a decided stream from the periphery toward the centre of the cornea, the same gradually passing inward to the anterior chamber. Ehrenthal was unable to confirm these results and with the latter my work leads me to agree entirely.

I.

EFFECTS OF FLUORESCEIN ON SLIGHT LESIONS OF THE CORNEAL SURFACE.

After anæsthetizing the cornea of a rabbit with a weak cocaine solution, slight cuts were made in various parts of the corneal surface and a 2½ % solution of uranin dropped freely upon them. In all cases, each cut was soon surrounded with a fluorescent border, densest in the immediate vicinity

[1] SCHWALBE. *Schutze's Arch. f. Mikr. Anat.*, vi., p. 316.

of the cut, and fading off gradually in the surrounding tissue; but instead of the fluorescence extending farthest from the cut on the side toward the centre of the cornea, as one would expect from Pflüger's article, the coloration extended with uniform rapidity in all directions, if care had been taken to make the cut perpendicular to the surface of the cornea. If it were made obliquely into the corneal tissue, there was sometimes a slight difference in the fluorescence on the two sides, the broader margin being on the side toward which the bottom of the cut inclined. From a cut made half-way between the centre and the periphery, the fluorescence spread with equal rapidity toward the periphery and toward the centre. From a cut at the summit of the cornea, the fluorescence progressed at apparently the same rate toward the periphery, as it did in the reverse direction from a peripheral cut. From a defect of the conjunctiva near the cornea, instead of seeing a corresponding corneal sector become fluorescent, as described by Pflüger, I could only observe the fluorescence spread out into the cornea in a semicircular or semielliptical form, according as the defect was short or long; differing in no way from the form of the fluorescent border of a corneal defect, taken at the same distance from the starting-point of the fluorescence. The different appearance given by the conjunctival defect is due to the white background of the sclera, which prevents our seeing plainly this starting-point. I have repeated these experiments on different animals a number of times, always with the same negative results.

II.

INTRODUCTION OF PIGMENT INTO THE CORNEA.

Morf (*loc. cit.*), as the result of a single experiment, in which pigment granules passed from the anterior chamber, along an anterior synechia, into the cornea and thence toward the periphery, concludes that there is a corneal lymph-stream passing from the centre toward the periphery. To test this point, india-ink suspension was injected into the left cornea of a rabbit at four points about equidistant

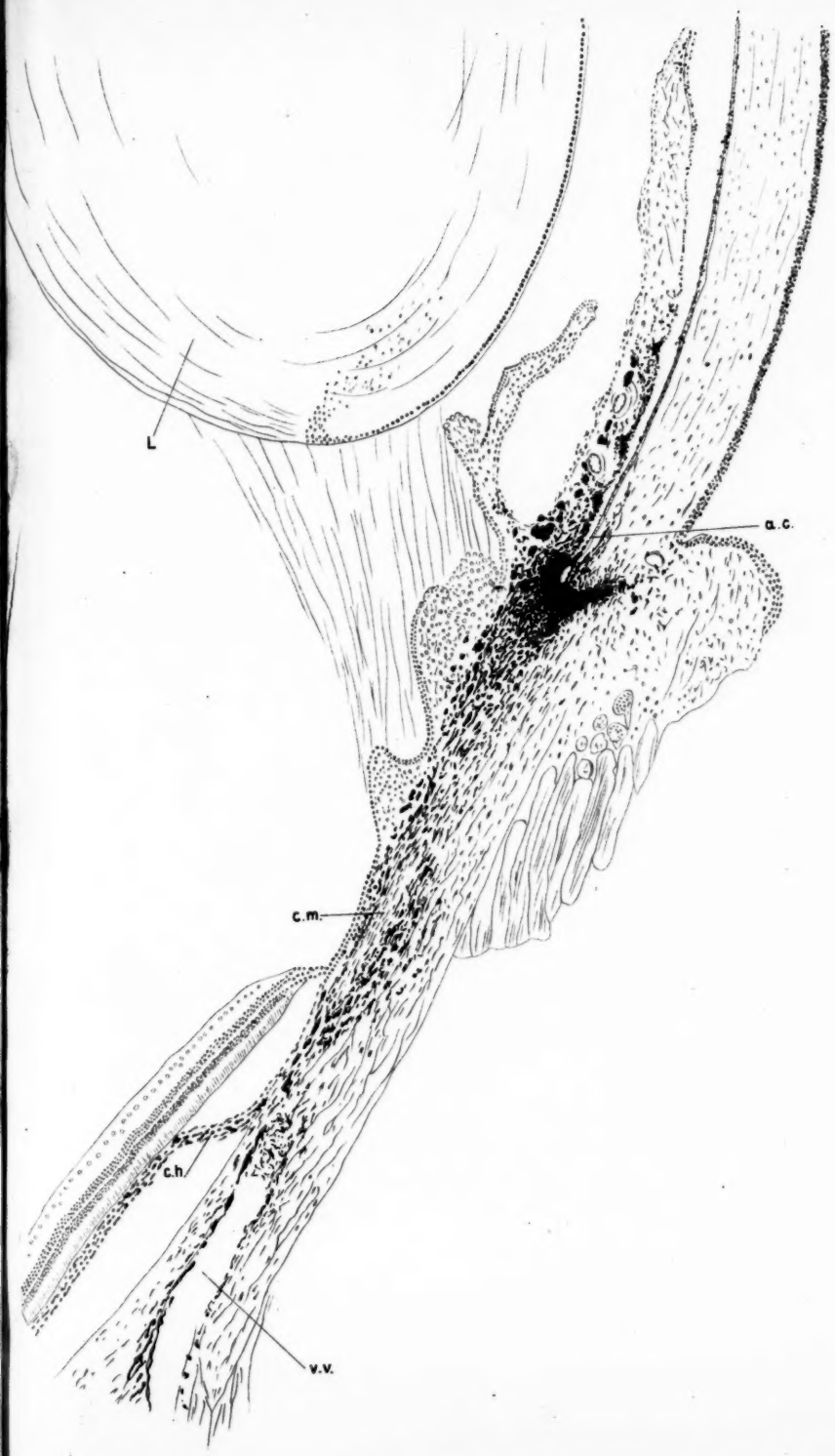
from each other and about half-way between the centre and the periphery. A hypodermic syringe was used and the ink passed hardly at all beyond the walls of the canal made by the needle, but enough remained behind to make a well-marked longish black spot at each point of injection. In the right eye of the same animal the cornea was pierced, and, with the needle of the syringe, the membrane of Descemet was scraped away at several points about half-way between the corneal centre and the periphery. A few drops of india-ink suspension were then injected into the anterior chamber. No considerable reaction followed. After about six weeks, the animal was killed and the cornea examined microscopically. Each quadrant was cut into sections corresponding as nearly as possible to radial lines from the centre to the periphery. In the left eye the pigment was found to have penetrated a short distance in all directions from the injection wounds, much of it apparently free, the rest in leucocytes and corneal cells. In some sections the pigment appeared to have penetrated considerably farther toward the centre than toward the periphery, while in others, the reverse was seen. On the average, however, there had been no noticeable difference between the progress made in the two directions. In the right eye, practically the same conditions were observed. Where the membrane of Descemet had been scraped off, the pigment had penetrated from the anterior chamber for a short distance into the cornea, but no positive difference could be observed between the extent to which it had extended toward the periphery and toward the centre.

These experiments indicate that if there be any lymph-stream in the cornea it is not of sufficient strength to influence perceptibly the movement of pigment particles nor the spread of fluorescein through its substance.

Summary.

(1) The ferro-cyanide and fluorescein methods are not calculated to give trustworthy results in determining the physiological currents of the eye. Many of the blue lines, obtained by the former method, represent simply the boun-

daries between tissue into which the ferro-cyanide has diffused and that containing none. The lines upon which most stress has been laid can be obtained perfectly well in the dead eye. (2) The view of Stilling that there is no outlet from the vitreous forward around the lens is incorrect. The zonula is freely permeable for solid particles, free pigment being carried regularly from the vitreous into the anterior chamber. The failure of the attempts to inject the anterior chamber from the vitreous is probably due to the closure of the chamber angle from the increased vitreous tension. It is probable that the fluid secreted by the ciliary processes, posterior to the zonula, divides into two portions, one part passing forward into the posterior chamber and thence through the pupil into the anterior chamber; the other passing back through the vitreous and out through the central canal of the opticus into the tissues of the orbit. (3) There is no evidence of any current passing from the posterior chamber through the iris root. Pigment-bearing leucocytes may pass into the latter from either posterior or anterior chambers, much more readily, however, from the latter, from which they sometimes pass clear through the iris into the posterior chamber. The blue line in the iris root obtained by the ferro-cyanide method can be obtained perfectly well in the dead eye. (4) There is no evidence of any current from the anterior chamber through the membrane of Descemet into the cornea. Pigment particles from the aqueous are taken up by the protoplasm of Descemet's epithelial cells; not so much by the cement-substance between them. Experiments on both dead and living animals show a free connection for non-diffusible substances between Fontana's spaces and the circumcorneal veins. It is therefore probable that the greater part of the aqueous leaves the eye in this way. Other finer lymph-channels lead from Fontana's spaces into the posterior layers of the cornea, into the perivascular spaces of the sclero-corneal junction (possibly), into the sclera, choroid, and peri-choroidal space. Wherever these channels communicate with spaces in which there is a lower pressure than that within the anterior chamber they must, on the whole, serve to some extent as outlets. This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also applies to the perichoroidal space, which, beside being connected with the intervaginal space, communicates with the space of Tenon by numerous lymph-channels surrounding the vessels and nerves which pierce the sclera. The rare cases in which Deutschmann and myself have observed a passage from the intervaginal to the perichoroidal space were probably due to exceptional causes. If there is any regular current here it is more probably from the perichoroidal to the intervaginal space. In these finer channels apparently free pigment seems to pass indifferently in any direction. (5) Between the retinal pigment-epithelium and the layer of rods and cones is a tolerably well defined space, from which pigment passes freely into the retina, but hardly or not at all into the choroid proper except along occasional penetrating blood-vessels in the neighborhood of the optic nerve. (6) While certain facts, such as the regular passage of pigment and bacilli from Fontana's spaces into the cornea and the progress of subconjunctival hemorrhages in the same direction, together with the impermeability of Descemet's membrane from behind, speak for the nourishment of the cornea from its periphery, the corneal lymph-stream, if any exists, is too weak to perceptibly affect the diffusion of fluorescein or the progress of pigment particles through its tissues.

Explanation of the Accompanying Plate.

The figure is drawn from an albino rabbit's eye, into the anterior chamber of which india-ink suspension had been introduced and left for a month before death. The drawing is a composite from two different sections, as I had not the good luck to find the passage of pigment into a blood-vessel of the sclero-corneal junction and along a vorticose vein as well, clearly shown in any one section. It should be remembered that in the rabbit the ciliary processes send prolongations far into the posterior chamber.

l. = Lens.
a. c. = Angle of anterior chamber.
c. m. = Ciliary muscle fibres.
ch. = Choroid.
v. v. = Vorticose vein.

BINOCULAR METAMORPHOPSIA PRODUCED BY CORRECTING GLASSES.

By HARRY FRIEDENWALD, A.B., M.D., Baltimore.

TWO years ago an interesting article by Dr. J. A. Lippincott appeared in these ARCHIVES,[1] under the above title. It described those peculiar disturbances of vision, such as a distortion of the sides of rectangular surfaces, etc., which patients sometimes complain of when they are provided with certain correcting glasses for *both eyes*, through which the vision of *each eye looking separately* is normal. The description of the phenomena, as produced by different glasses under varying conditions, is exceedingly careful; there is little that need be added. The manner in which he explains the phenomena is unsatisfactory. The proper explanation has been suggested by Dr. John Green.[2]

This subject has received little attention. The best works on refraction[3] do not mention it. Beside the articles cited above, there are only one by Culbertson[4] and several by Savage[5] bearing upon it. Both of these writers agree upon a rotation of the eyeball upon its antero-posterior axis as the cause of the phenomena, and Savage develops theories of an "harmonious non-symmetrical action," and recently of an "harmonious symmetrical action of the oblique muscles." These explanations are false in theory and dangerous in practice. In theory they have led Savage to accept unwar-

[1] Vol. xviii., No. 1, p. 18.
[2] *Transactions Amer. Ophth. Society for 1889.*
[3] Donders, Mauthner, Landolt.
[4] *Am. Jour. of Ophth.*, May, 1888.
[5] *Journ. of the Am. Med. Assoc.*, November 5, 1887. *Am. Journ. of Ophth.*, September, 1888, p. 245. *Ophth Record*, vol. i., No. 1, p. 1.

ranted strains and insufficiencies of the oblique muscles; in practice he, as well as Culbertson, recommends altering the position of the axes of the cylindrical glasses, as found on careful examination of each eye separately to correspond with the supposed rotation of the eyeball.

In studying the phenomena, we find that they are also observed by emmetropic eyes when looking through certain glasses. They can therefore be repeated easily and verified.

The numerous appearances may be reduced to a few elementary forms, which we shall formulate below. They may be demonstrated by allowing the emmetropic observer to look at a square surface[1] held vertically before the eyes. Placing a convex cylindrical glass before the right eye, we find that the square surface appears as a trapezoid,

a. with axis at 45° t, the lower side seems lengthened, the right side inclined.
b. " " " 45° n, the upper side seems lengthened, the right side inclined.
c. " " " 0° v, the right side seems lengthened, the upper and lower sides inclined.
d. " " " 90° h, the right side seems shortened, the upper and lower sides inclined.

Placing the glass in symmetrical positions before the left eye reverses these figures. On substituting a concave for the convex cylindrical glass, we find that the same sides are affected as above, but those that seemed lengthened before appear shortened now, and *vice versa*. Thus, with a concave cylindrical glass placed before the right eye,

e. at 45° t, the lower side seems shortened, the right inclined.
f. " 45° n, " upper " " " " " "
g. " 0° v, " right " " " the upper and lower sides inclined.
h. " 90° h, the right side seems slightly lengthened, the upper and lower sides inclined.[2]

[1] In demonstrating this to the Med. and Surg. Society of Baltimore, a card 12 *cm* square was used. Other objects are equally good. In general, a cylindrical glass of 2 D is found most useful.

[2] In these statements the effect mentioned is the most prominent. A slight change of a contrary character in the opposite side is frequently noticed; for example, in c. it is evident that while the prominent change is a lengthening of the right side, there is also slight narrowing of the left side.

When glasses of equal strength are placed in symmetrical positions before both eyes (as, for example, 45° t for each eye) their effect is very much increased. If the axes, on the other hand, point in the same direction (whether horizontal, vertical, or in any other position), the effect of both glasses will be the same as of each one singly, namely, of causing lines of dispersion only, and if the axes are oblique, slight slanting of the object looked at.

A peculiarity of utmost importance, but which Lippincott does not mention, is that the side which appears lengthened seems to be more distant and the side that appears shortened to be nearer, though we may convince ourselves that the plane of the surface is perpendicular to our visual axis. This fact proves that the change depends upon stereoscopic illusion.

Before going farther, it is necessary to mention the effect of cylindrical glasses upon the retinal images. This has been worked out in detail by Lippincott.[1] It is shown that cylindrical glasses with oblique axes cause slight obliquity of the retinal images, the obliquity approaching the direction of the axis when concave cylindrical glasses are used, and receding from it with convex cylindrical glasses. This obliquity affects all lines that do not run parallel to the axis of the cylindrical glass or perpendicular to it. If, then, the figure looked at be a square held vertical with upper and lower edges horizontal, the retinal image will appear slightly tilted to one side or the other, accordingly as convex or concave cylindrical glasses are used at oblique axes.[2] Besides the image is more or less indistinct, on account of dispersion. On the other hand, it is evident if the same object be looked at through a cylindrical glass with axis vertical or horizontal, that though the direction of the sides (and all lines parallel to these) will remain unaltered, the effect will be an

[1] *Loc. cit.*

[2] The obliquity and slight incongruity of the retinal images has induced Dr. Savage to construct his hypothesis of a necessary rotation of the eyeball, for he says "there must be double vision, unless the oblique image in the (one) eye and the horizontal image in the (other) eye can be made to occupy corresponding parts of the two retinæ. This can be effected alone by the *harmonious symmetrical action of the oblique muscles.*" (*Ophthalmic Record*, vol. i., No. 1, p. 11.) This is an error. Double vision is not the result, but the images are fused into one.

obliquity of all other lines upon its surface, especially of the diagonals, and the resulting figure will be a rectangle.

The binocular fusion of such an altered image with one that is unchanged, or changed in a different manner causes *stereoscopic appearances of solidity and depth.* In consequence of this there is also a change in the apparent length of lines, for these vary according as we project them nearer or further from us. The lines of dispersion clear up to some extent, and a more definite mental picture is produced.

Now, if images which are slightly dissimilar can be fused into a single mental picture, it remains to be inquired whether the slightly dissimilar images produced upon the retinæ of emmetropic eyes by a cylindrical glass fall under this head. Place such pictures in a stereoscope, and the mental impression will be found to be identically the same as that produced by the cylindrical glass placed before the eye. For example, place before both eyes + 2 D, cyl. Ax. 45° t. The resulting retinal images of the square card are parallelograms. Insert two similar parallelograms in the stereoscope. In both ways you receive the impression of the same form of trapezoid, narrow at the top, and which is apparently *leaning forward* so that the top seems to be much nearer the eye than the base. *This proves that they are fused in the same manner; the appearance of depth points conclusively to the fusion of dissimilar images.* The experiments can be repeated for all the figures, whether produced by cylindrical glasses with oblique or with vertical or horizontal axes.[1] This suffices to explain the effect of cylindrical glasses on emmetropic eyes.

What is the effect on astigmatic eyes? Practically the same. Astigmatic persons have retinal images distorted to conform to their astigmatism and its axis, just as the emmetropic have when provided with cylindrical glasses. But having seen in this manner from childhood, they see things as they are and not distorted, for visual judgment is the result of experience. Correct their astigmatism and produce

[1] Cases d and h in the tables may appear anomalous, because the glasses have very different effects, if looked through with but one eye. The difficulty disappears when we remember that the lengthening or shortening depends entirely upon the apparent distances of the parts of the stereoscopic image.

better and more accurate retinal images; yet at the same time you cause a relative displacement to what has previously been the position of retinal images. One of the factors upon which visual judgment relied will then be disturbed and consequently the mental picture will be distorted. This distortion is the same as when cylindrical glasses are placed before the eyes of the emmetrope, as can be readily demonstrated. Let us cite one case. A lady who had suffered considerably from eye-strain and headache was provided with the following glasses, which gave full vision: Both eyes + 1.25 D, cyl. Ax. 75° n. When allowed to use both eyes she had great metamorphopsia; a book which she held in her hand appeared wider at the top, the floor seemed to be going down hill before her, the wall appeared to be inclined backwards. This is the same effect as produced upon a person with normal eyes with the same glasses. Two weeks afterward, having worn them continually, she returned and said that she had had much difficulty in wearing the glasses during the first few days but that she could now see very well with them. On examination it was found that the metamorphopsia had almost disappeared. On taking off the glasses, however, it immediately returned but changed, for now the floor seemed to rise before her, a book or a square appeared narrower at the top, etc.; without her cylindrical glasses she was exactly in the position of an emmetropic person with concave cylinders in the same position as above.

There is still another theoretical aspect of this subject which needs attention. On examining the tables above, it will be found that a cylindrical glass has opposite effects, according as the axis is horizontal or vertical. Lippincott,[1] moreover, has found, and we have verified his statement, that these effects are not equal, but that the *effect is greater when the axis is vertical than when it is horizontal.* Consequently if two equal cylinders are placed upon each other with their axes at 0° v, and at 90° h, respectively, they but partly neutralize each other, *the vertical cylinder having a preponderating influence*, and thus their combined

[1] *Loc. cit.*

action is equal to that of a weaker cylinder with its axis placed vertically. But two equal cylinders placed upon each other with their axes at right angles are optically equal to a spherical glass of the focal power of each cylinder.[1] This gives us the solution of the problem of the very annoying metamorphopsia[2] due to prescribing unequal glasses for anisometropia without astigmatism. If both eyes of an anisometrope are corrected, the optical difference between the glasses causes the same effect as a cylinder with its axis vertical; the square test-card as well as all other objects looked at, appears much wider on one side, and this gives rise to great annoyance. The explanation agrees thoroughly with the facts. As examples take the cases furnished by Lippincott[3]: RE plano, LE + 1 D. The left side appears wider. Or to quote from my records: "RE —0.75, S = $\frac{20}{xx}$, LE emmetropic, S = $\frac{20}{xx}$. RE reads best with a plano, L E with plus .75; left side appears wider." To quote another case: "RE + .25, S = $\frac{20}{xx}$; LE + 2.5, S = $\frac{20}{xxx}$; RE reads best with + 1.75; LE with + 4 D; left side appears much wider."

Thus we have found that the various forms of metamorphopsia—1st, that due to cylindrical glasses with axes oblique, 2d, that due to cylindrical glasses with axes horizontal or vertical, 3d, that due to a spherical glass (as in anisometropia)—require but one explanation.

It is useless to spend any time in refuting other theories that have been advanced, but it may not be without interest to mention them. The theory of the rotation of the eyeballs has been referred to above. Lippincott[4] thinks there are "reasons for supposing the explanation to be connected in some way with accommodation," though he admits that "in a number of thoroughly atropinized eyes precisely the same results, both in kind and degree, followed the use of cylinders," as in non-atropinized eyes, and he therefore sug-

[1] Mauthner, *Optische Fehler des Auges*, p. 717.
[2] Landolt, *Refraction and Accommodation*, Eng. trans., p. 527.
[3] *Loc. cit.*, p. 23.
[4] *Loc. cit.*, p. 26.

gests a change in the "accommodative impulse." The accommodative impulse, he assumes, is affected unequally and varies with the position of the axis. There is nothing to sustain this hypothesis.

The phenomena under discussion are not always described by patients. But it is rare that they do not recognize them when their attention has been directed to them. They frequently complain of the great disturbance of vision, headache, pain in the eyes, and dizziness, even when unable to describe the trouble. The metamorphopsia manifests itself most when patients look at the floor when walking, or when going down a flight of stairs. If the metamorphopsia is such that the square trial-card appears broad at the base, everthing else that is looked at will show the same change. Moreover, that part of every image which lies lowest in the field of vision will appear more distant. The lower part of the wall will appear farther away; the wall will seem to incline forward. That part of the floor nearest the feet, lying lowest in the field of vision, will appear very deep, and therefore the floor will seem to rise before the person. On the other hand, if the metamorphopsia is such that the test-card looks narrower and consequently nearer at the base, then the part of the floor where the person is standing seems to be very high; it will appear as though it could almost be touched with the hands, though standing erect, and the person will feel very short. Metamorphopsia, which will cause one of the sides of trial-card to appear broader or narrower, will give rise to the appearance of slanting from side to side when the floor is the object gazed at. Patients suffering with this form of metamorphopsia, when writing on unruled paper, find that their lines run up or down and are not parallel with the upper border of the sheet. The disturbances wear off in a few days, depending partly upon the strength of the glasses and partly upon the persistence with which they are worn. If they are worn only at times, as when reading, the metamorphopsia will last for a long time. This suggests that such patients be advised to wear their glasses continuously, unless this is otherwise contraindicated.

It is evident from what has been said that binocular metamorphopsia may be produced in other ways[1] than by correcting glasses. As an instance let me cite the following case: A patient who had complete atropine mydriasis of the left eye, but whose eyes were otherwise normal, found that the floor appeared to slope downward toward the right side (the right side of a book looks wider than the left), etc.[2]

In conclusion, it is of interest to point out that the phenomena of binocular metamorphopsia throw some light upon the physiology of vision in ametropic eyes. It is shown by the frequency with which metamorphopsia is met with that most ametropic persons are able to fuse their imperfect retinal images and to form judgments of distance just as emmetropic persons. This implies, in other words, that identical points in the retinæ depend, to a great extent at least, upon experience.

We can also account for the advantage of binocular vision over monocular vision when both eyes are equally deficient, for the fused mental picture of two equally imperfect images is more distinct than either one of its components.

The constancy with which the phenomena of metamorphopsia are met with even in the lower degrees of astigmatism is a strong argument against the theory of irregular ciliary contraction and compensatory accommodation. For if such low degrees were neutralized by accommodative effort, then the phenomena of metamorphopsia would be absent when this correction is substituted by that of glasses. As mentioned above, this does not occur, and I have always been able to evoke the phenomena.

The phenomena of metamorphopsia may be made use of in the examination of binocular vision as already suggested by Lippincott.[3] I have examined several cases of congenital amblyopia of one eye and found that the imperfect eye

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[1] For a discussion of the effect of prismatic glasses on binocular vision see *Graefe and Saemisch*, vol. vi., p. 366.

[2] The visual discomfort arising from monolateral paralysis or paresis of the accommodation is similarly explained.

[3] "New Tests for Binocular Vision," *New York Med. Jour.*, Sept. 27, 1890.

takes part in the visual act by fusing its image with that of the better eye. In strabismus I have never been able to find metamorphopsia, as would be expected from our knowledge of the binocular vision of squinting eyes.[1]

[1] "Recent Investigation in Strabismus," *N. Y. Med. Jour.*, Aug. 16, 1890.

AN IRIS SHIELD—A NEW CATARACT INSTRUMENT.

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(*With a wood-cut.*)

IN extraction by the simple operation, capsulotomy, whether performed by means of the Graefe cystotome or with the curved toothed-forceps, always exposes the iris to more or less risk of injury during introduction and withdrawal of the instrument; the sharp point of the cystotome or the projecting teeth of the capsule-forceps easily become entangled in the loose tissue of the iris; or the inner surface of the cornea may suffer abrasion in attempting to avoid the iris. To obviate the above difficulty, the instrument here illustrated and described suggested itself recently to the writer; its simplicity and efficacy are its own endorsement.

It is simply a small, thin plate of silver fastened edgewise to a flexible silver shank; the flexibility of the latter allowing the shield-plate to be placed at will at the most convenient angle with the handle. It is applicable to either eye and for use in right or left hand; when the forceps are used in the right hand, the shield is of course held in the left, or *vice versa*.

The shield-plate is introduced into the corneal wound and covers the adjacent section of iris, its inner edge extending

just to the margin of the pupil. The tip of the forceps or the cystotome is introduced lying upon the upper surface of the shield, and thus is prevented from contact with the iris; slight pressure upon the iris produces a free space between the shield and inner surface of cornea, and thus abrasion of the latter is easily avoided. The shield-plate must be perfectly smooth and only so thick as to give it the necessary strength. The accompanying illustration shows the size of the instrument.

ON VACCINE BLEPHARITIS.

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ONLY a few cases of vaccine blepharitis (vaccine-ophthalmia, vaccinia of the eyelids, vaccine, vaccinula on the border of the eyelids) with subsequent affections of the eyes are published by Hirschberg,[1, 2] Senat,[3] Hervieux,[4] Berry,[5] Schapringer,[6] J. T. James,[7] Peiper,[8] Schirmer,[9] so that a further contribution will not be superfluous.

H. P., a boy twelve years old, was brought to my office by his father, October 31, 1891, on account of an inflammation of his right eye. The right lower lid showed two ulcerating patches at the ciliary margin, close to the external canthus. Both lids were slightly œdematous. These patches bearing a great resemblance to vaccine pustules in the ulcerating stage, I at once asked the father whether the boy had been recently vaccinated, which, however, had not been the case, and neither of them knew that he had come into contact with anybody who had been vaccinated. I gave him hydrarg. oxydat. flav. ointment, and ordered cold applications. The next day the father came alone, stating that the eye of his son had become very much inflamed, so that he could not see out of it, and that the left eye was commencing to get sore. At his residence I found the following condition: The right upper lid is red, intensely swollen, overhanging the lower one, and cannot be raised voluntarily; it feels hard to the touch, which causes pain. It cannot be everted, but lifted with the finger it shows the conjunctiva infiltrated by a gray membranous exudation, which cannot be wiped away. Thin yellow fluid is discharged. The ocular conjunctiva is in a state of in-

tense chemosis, but not coated. The cornea is perfectly clear. The conjunctiva of the lower lid exhibits the same appearance as the upper one, and the ulcers at the ciliary margin are likewise covered by a grayish-yellow material. The left eye shows slight œdema of lids and some mucous discharge, but is open, although the palpebral fissure has become smaller. The right preauricular and submaxillary glands are considerably swollen and tender. Both tonsils are inflamed and very much enlarged, but without pseudo-membranes. Swallowing is painful, and he has fever and general prostration. Upon renewed inquiry as to the etiology of the two ulcers, I learned that the younger sister of the patient, who was occupying the same bed with him, had been vaccinated in school a few days previously on her left arm, which presented a pretty large ulcer covered by a scab. Both eyes were treated with cold applications day and night (the pieces of linen used for each eye being kept on separate blocks of ice in separate dishes) and irrigated and washed with chlorine water. The swelling disappeared gradually, so that on November 4th a better aspect of the grayish infiltrated conjunctiva could be obtained. The chemosis was still very large, projecting as a thick red wall around the cornea. The latter remained entirely clear. On November 7th he could open the right eye, which was discharging more freely now. The inflammation of the left eye had been arrested from the first day. On November 12th the patient could come to my office, where the conjunctiva was found to be free from membranous deposit, but, being still red and velvety, was treated with a 3 % solution of nitrate of silver. The condition improved steadily, so that on December 16th nothing of the disease was left but a slight redness of the ciliary borders, and a moderate ptosis of the right upper lid, which, however, did not cause any annoyance. No scars and no change in the position of the lids or cilia. Cornea perfectly clear. V = 1.

Although the boy and his parents were not aware of the manner in which the inoculation of the vaccine virus was effected, it was undoubtedly caused by an accidental transmission from the vaccinated arm of his sister. In one of Berry's[3] cases a direct transference of lymph took place, owing to the child's arm being often in contact with its mother's face; in another the handkerchief used for wiping the vaccinated arm was admittedly used by the mother also.

Cook's[11] patient had most likely infected himself, not from the baby directly, but from a towel that had been used in drying it. Darling[10] observed vaccine vesicles on the eyebrow of a farm-servant, who was in the habit of milking cows, and very likely got it from them, although she could not remember if any of the cows had sores on the teats. Senat[3] saw a military surgeon who had a vaccine pustule at the left lower lid, with corneal ulcers, caused by lymph squirting into his eye from the pocks of a young cow, while he was vaccinating soldiers.

To decide the question whether there was any lesion of the ciliary margin or not for the introduction of the virus was not possible in this case, as it will hardly be in others, unless it presented itself very conspicuously. And then it will become rather unimportant, if further experimental investigations will prove that even a general infection from the intact conjunctiva may follow, as Braunschweig[12] found it with Ribbert's bacillus of intestinal diphtheria in the conjunctiva of rabbits. (He was unsuccessful, however, with staphylococcus pyog. aur., anthrax, septicæmia of mice, chicken cholera, and tetragenes.) Most frequently the vaccine vesicle developed on the border of the lower lid, causing a consecutive ulcer on the corresponding portion of the upper lid by direct contact. In our case (and one of Schapringer[6] and Berry), it was confined to the lower lid. The affection of the conjunctiva, starting from the two ulcers, had the aspect of diphtheritic conjunctivitis. Although observed by others and not taken for diphtheritic, our case appears different, on account of the considerable swelling of the preauricular and submaxillary glands and tonsils, the constitutional symptoms, as fever and general prostration, and in the propagation to the second eye. If a so far healthy conjunctiva may become the seat of a diphtheritic inflammation, why should not the same occur in an eye predisposed by ulcers at the ciliary margin, no matter of whatever origin? Plastic inflammation, with an exudation in the substance of the conjunctiva, was present, and this is the chief local symptom in simple plastic, pseudodiphtheric, croupous, and diphtheritic conjunctivitis, which

are various grades of the same pathological condition, differing from each other only in intensity.

The *diagnosis* is, of course, easiest when the vaccinia is observed in the first stage, exhibiting the typical vesicles pitted in the centre. Most cases, however, presented the ulcerating pustules, as in ours, having such a characteristic appearance that they are readily recognized. In later stages, however, the diagnosis may become very difficult. Syphilitic ulcers, which have a different appearance, cause also such hard infiltration of the lids, but they require a time of incubation not less than at least twelve days,[4] and, as well as a tubercular affection, run quite a different course. As the only complication on the eyeball itself, inflammations of the cornea have been noticed in seven cases of vaccine belpharitis by Hirschberg, Senat, Schapringer, Schirmer. Schirmer[9] once observed a superficial marginal infiltration, twice a very tedious keratitis profunda with peculiar ring formation. Leber[13] mentioned that Critchett saw a purulent affection of the cornea from an injury of the latter by a lymph-lancet. There are some other reports on affections of the eyes in vaccinia, in which the latter were only secondarily suffering from vaccine pustules situated not on the lids themselves, but on neighboring parts, as on the eyebrow and cheek (Darling[10]), on the malar eminence ⅛ of an inch from the external angle of the eye, with huge œdema of the eyelids completely closing the eye, the glands being very much enlarged and tender (Cook[11]), and an indurated ulcer at the angle of the eye (Hervieux[4]). The preponderance of females and adults, pointed out by Berry and Schapringer, finds, I think, a natural explanation in the fact that these are more exposed to contagion, being chiefly engaged in nursing and handling children, from whom, in most instances, the infection took its origin. Although most cases recovered perfectly, their occurrence might be avoided altogether, if the source of infection, the vaccinated place of the body, were protected by proper dressing, the enforcement of which is the duty of every physician who performs vaccination.

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10. DARLING, *Brit. Med. Jrl.*, 1890, p. 1362.

11. COOK, *Brit. Med. Jrl.*, 1891, p. 284.

12. LEBER, the same as 9.

13. BRAUNSCHWEIG, *Fortschr. d. Med.*, vii., p. 921–928; *Centralbl. f. Chir.*, 1890, p. 372.

IDIOPATHIC VITREOUS HEMORRHAGES.

By Dr. JAMES A. SPALDING, Portland, Me.

IDIOPATHIC vitreous hemorrhages are so rare (Nieden saw but six cases in thirty-four thousand patients) that it seems well worth while to bring before the readers of the ARCHIVES, after a long silence on this topic in the ophthalmic literature of this country, a report of a few new cases of this unusual affection.

It is of the greatest practical value to the student, as well as to the practitioner of medicine, now and then to reopen old topics like the one at the head of this article, for we thus refresh our memories with the opinions of other observers, we recall our former doubts and fears in regard to the result of apparently so serious a case, and, most interesting of all, we bring back to mind apparently similar cases in which, although the treatment had been eminently successful, we are forced to acknowledge to ourselves that our diagnosis had been entirely at fault.

Whilst vitreous hemorrhages are sometimes perplexing in their diagnosis,[1] especially to those whose practice is not extensive, and often tedious in their recovery, it is nevertheless pleasant on the whole to be able to assure our patients that useful vision will in all probability be regained. And this is all the more agreeable, when both eyes of a busy man are, for instance, so abundantly filled with hemorrhages, that for weeks he is unable to attend to his work, though ultimately he recovers *useful vision* in one if not in both eyes.

[1] I will at once exclude all vitreous opacities of whatever nature occurring in myopic eyes, all hemorrhages of a traumatic origin, and the ordinary run of vitreous opacities in which a vitreous hemorrhage can with all probability be denied.

The chief reason, however, why I have gone to the trouble of looking over my case-books, and consulting all accessible authorities in regard to the causation, prognosis, and treatment of vitreous hemorrhages, is because *one of my cases had for months been treated in vain as a case of double detachment of the retina.*

From the fact of an erroneous judgment in these cases, I think that we can easily see how some of the cases in our journals hailed as cure of retinal detachment after one and another sort of treatment have actually been nothing more nor less than the simple cure of a vitreous hemorrhage.

The chief cause for this error in diagnosis lies, in my opinion, in the fact that if the extravasation is partial or has retrograded at all, we may see through its interstices a greenish reflex, which bears so great a resemblance to a detachment of the retina that, heedless of *the perfect visual field*, a detachment is diagnosticated. As the resorption of the hemorrhage advances, the observer sees this green reflex resolve into green bands either in the retina itself or else in the posterior portion of the vitreous. And even after the cure of the detachment so called, and the restoration of vision, there the bands remain, rising above the level of the retina, but without the overlying retinal vessels. Thus in one of my cases, the margin of the papilla with the refraction ophthalmoscope was *Em*, a portion of the green ridge-like elevation + 2 D, and the summit of the same + 4 D, above the level of the retina. Perhaps this elevation represents a hyperplasia of the retina, or a cicatrix in the retina, similar to that depicted in Jaeger's Atlas (Fig. 84), and in which a *new formation of tissue in the vitreous* was diagnosticated. The exact locality of the elevation can only be defined by the presence or absence of the retinal vessels.

It is still an open question whether the blood in the vitreous escapes from the choroid through the retina, and so into the vitreous, or whether it actually arises from the retina. As I have never seen any traces of a retinal hemorrhage at a time when the vitreous has cleared, I am inclined to think that there can be no question of the hemorrhage

arising exclusively from the choroid, and rather in front toward the ciliary region.

Before reporting a few cases, I may venture to quote, in the briefest possible fashion, a few accessible authorities, and chiefly in so far as their words throw any practical or pathological light on the subject in hand.

Swanzy remarks that vitreous hemorrhages are not uncommon, and are the result of those diseases of the retina and choroid which are accompanied with hemorrhages into those membranes. He gives no especial diagnostic signs or treatment, except in the section on ordinary vitreous opacities; Heurteloup's leech, dry cupping, and pilocarpine hypodermatically are suggested.

Wells gives a satisfactory account of the symptoms and treatment. His prognosis is bad. The hemorrhage is likely to recur and permanent opacities to remain. The retina is almost always detached, and we may later see the cicatrix. Treatment: Heurteloup, attention to the health, saline cathartics, and sometimes a compress bandage.

Schweigger offers a poor prognosis. A few forms of inflammatory origin may recover. Recurrent hemorrhages are fatal to the sight. When the opacity clears off we may discover a retinal hemorrhage, which has possibly excited the hemorrhage into the vitreous. These occur most often in young people. Syphilis and hemorrhoids may be the chief indications in our treatment, which is not encouraging.

DeWecker has often seen hemorrhages from the papilla. Whilst isolated hemorrhages may resorb with astonishing rapidity, recurrent hemorrhages into the vitreous constitute a desperate disease. The younger the patient the more favorable the prognosis. Pilocarpine into the eye and hypodermatically, the constant current, and Heurteloup are highly praised.

Galezowsky has an excellent chapter on this topic. He insists on the impossibility of illuminating the fundus; all light is absorbed by the effused blood; the effusion clears off not by a succession of levels, but by a succession of tints. Sometimes the effusion looks red by oblique illumination. Mauthner opposes this assertion, but Loring agrees with it.

The disease is generally in one eye alone, and is due to rupture of the ciliary vessels. The original cause is to be sought for in the suppression of habitual epistaxis and of the menses, in hemorrhoids, and in constitutional disorders. Detachment of the retina ought never to be confounded with vitreous hemorrhages, for in the former we have loss of a portion of the field, and additionally we can see the retinal vessels coursing over the detached portion of the retina.

The most favorable cases are those in which the effusion lies in the anterior portion of the vitreous, because of the abundant vascularity in that region. The older the patient the slower the recovery. Atropine and eserine alternately, warm fomentations, friction on the temples, cupping, blisters, iodide of potassium, pilocarpine hypodermatically, salines, and even an iridectomy, are suggested in the line of treatment.

It would take too much space to relate all of the cases of vitreous hemorrhage discoverable in modern literature, but I will very briefly cull a few of the most interesting for those who care to study this interesting topic.

Daguenet thinks that the blood in his six cases came from the choroid. Albuminuria, irregular menstruation, and atheroma of the arteries must not be overlooked in the etiology. Relapses are more frequent in the youthful than in the aged. The rupture probably takes place far back in the fundus of the eye, a fact not excluded by the presence of the clot directly behind the lens.

Abadie has frequently seen the vitreous hemorrhage preceded by epistaxis.

Talko examined the eyes of a patient killed by a fall. Blood in the intravaginal spaces of both optic nerves, but the hemorrhage into the left vitreous had no connection with the blood in the spaces. Indirectly, this effusion in the intravaginal spaces had compressed the left optic nerve and its central vein till it burst near the yellow spot and the blood exuded into the vitreous. The pathology in this case may explain that in others of non-traumatic origin.

Nieden and Eales have called attention to recurrent vitreous hemorrhages in young men. They emphasize the sudden

blindness, the lack of evident cause, and the favorable prognosis. The hemorrhage arises in the choroid. One eye only is generally affected in emmetropic patients, vision generally completely restored in time, but usually after one or more relapses. Mercurials and the iodide of potassium are advised.

Mooren attributes some cases to rheumatism, or to sudden cold, owing to which the ciliary vessels are rapidly depleted. The stress of treatment is to be laid on the rheumatic nature of the affection. Mercurial inunctions are highly praised.

Hutchinson thinks that recurrent vitreous hemorrhages are almost invariably seen in young men alone, and in both eyes. Unilateral hemorrhage, on the contrary, is a senile affection, and occurs about equally in both sexes.

Porteret has written concerning nine cases of this disease. The cause was unknown in six. In one it followed eclampsia, and two of the patients were drunkards with atheromatous arteries. Two of the patients recovered, three improved, two remained the same, and two lost their sight entirely. The treatment consisted in the use of the constant current and antisyphilitic measures.

Unterharnscheidt suggests the possibility of an apoplexy between the retina and the vitreous, simulating vitreous hemorrhage, and Badal has shown that *this may occur* without perforation of the hyaloid membrane.

Amongst isolated cases I will venture to quote the following as perhaps throwing light on the etiology of this rare disease:

Jacobson saw periodic hemorrhages with epistaxis.

Cognet observed the same coincidence and additionally convulsions.

Hutchinson saw a patient one of whose eyes had already been destroyed by hemorrhages and apparent glaucoma when seventeen years old. The other eye later exhibited hemorrhages in the retina and vitreous, without glaucomatous symptoms. Constipation, epistaxis, and irregular heart. Gout in the family. The vitreous hemorrhages in the eye first lost may have originated from the retina.

Mayweg saw a young man of eighteen who had previously lost the left eye from recurrent vitreous hemorrhages, and now presented himself on account of what he asserted was the fourth attack of hemorrhage into the vitreous of the right eye, that condition having been three times before diagnosticated by competent men. Six relapses followed in rapid succession, and the sight was reduced to perception of light. Finally the right common carotid was ligated, with the result of effecting a permanent cure, so that after several months vision remained at $\frac{20}{100}$ with a normal ophthalmoscopic image.

Dor observed repeated vitreous hemorrhages in a girl of fourteen who had never menstruated; after establishment of this function the hemorrhage ceased.

Dujardin had a male patient who suffered from recurrent hemorrhages, first in one eye and then in the other, and he never was able to discover the cause.

Schiess' patient was a boy of twelve who suddenly became blind in both eyes whilst at school. "A blue cloud," as he expressed it, "came down over his sight." He never saw again.

Constipation is the one cause quoted by nearly all the writers on vitreous hemorrhages.

In regard to the treatment I would say that the whole question was very freely discussed as far back as 1864 at the Heidelberg Congress, and v. Graefe, as well as many others, were inclined to think *that the result was about as good if left to nature, as if every remedy in the pharmacopœia were administered in rotation.*

In conclusion, I will now report six cases from my private practice:

Case 1.—A man aged twenty-two lost the sight of his left eye a few hours previous to coming to me. He knew of no other cause than that he had been sawing wood. After resting a while, "a greenish veil dropped down over the eye." This attracted his attention, so that on covering the other eye he perceived that the left eye was blind. Ophthalmoscope revealed nothing but a black cloud. The fundus could not be illuminated with the mirror. This being my first case, I remember telling the attendant physician that the case was one of detachment of the retina. Under the influence of iodide of potassium in small

doses, given for lack of anything better then available (this was in 1874), the sight recovered to $\frac{20}{200}$. Two years later the patient had useful vision, being able to read, though long words had to be spelled out, Snellen 6. Some years later, S = $\frac{20}{40}$. The ophthalmoscope revealed a greenish opacity in the vitreous directly in front of the optic papilla. The yellow spot was not implicated, but as the patient looked at objects, the floating opacity in the vitreous sank down before anything that he was reading, hiding it temporarily. Ten years later, with a weak cylinder, + 0.25 D, axis 90°, S = $\frac{20}{20}$. Right eye normal throughout.

A delicate opacity extends from the margin of the papilla to near the posterior capsule; the greenish hyperplasia in the vitreous remains as before.

Case 2.—S. D., a man of thirty-five; March, 1885. Total loss of sight, right eye, since December. This began in August without pain. A sudden mist before the eye. The left remained normal till a week before consulting me, when it began to fail so rapidly that whereas, a fortnight before, he could read ordinary type with this eye, he could at present scarcely count fingers at 18″. Right eye detects the movement of shadows close before it. Ophthalmoscopic examination: Right, impossible on account of a dense opacity in the vitreous. No distinctive color on oblique illumination. Left, a dark greenish reflex from the fundus, directly in centre of visual axis. In the periphery some dense black vitreous opacities.

Heurteloup to each temple. Iodide of potassium in increasing doses up to four grammes daily in divided doses. Later, mercurial inunctions were used for considerable time. Fluid extract jaborandi in suitable doses had a visible effect on the opacities, so that when they gradually lightened the posterior layer of the vitreous exhibited the same green elevations as in the former case. That the hyperplasia was in the vitreous and not in the retina, seemed demonstrated by the absence of the overlying retinal vessels, as we see them in detachment of the retina.

The highest point of the greenish "neoplasm," if it may be so styled, was about 4 *mm* in front of the retina.

A year later sight in the right eye $\frac{20}{60}$, left eye $\frac{20}{40}$; a very remarkable improvement. The man is now, and has been ever since, earning the daily wages of the average workman.

Case 3.—A young lady aged eighteen lost the sight of the right eye in July, 1890, without any visible cause, except, perhaps, too

much use of the eyes at night. Perception of light. Fundus not illuminable. After using iodide of potassium six months the sight began to improve, so that fingers were counted. No green reflex. Pilocarpine injections were now freely employed, with the effect of increasing the sight considerably. A constant battery was then used and the sight cleared still further up to $\frac{20}{100}$. After several other attempts with pilocarpine, mercurial inunction, mercurials internally, and large doses of the iodide of potassium, the patient ceased to follow any treatment. The sight is at present $\frac{20}{100}$, Sn. 8 with some difficulty, but after all this is useful vision in case the good eye were lost or injured.

Case 4.—A young man of thirty-two came home with an uneasy feeling in his eyes, from a concert where he had been facing a very bright electric light. On waking the next morning he perceived a black cloud in front of the right eye. Extensive hemorrhage into the vitreous visible as a reddish cloud behind the pupil with oblique lumination. No trace of fundus; perception of light. Pilocarpine injections $\frac{1}{10}$ grain producing profuse expectoration, twenty injections on alternate days. The sight gradually improved. No green reflex. The iodide was then given in increasing doses up to 3 grammes daily. Result after seven months, $\frac{20}{20}$ and Snellen 6. No traces in the retina of any disease, and only a slight opacity far back in the vitreous.

Case 5.—Is very much like the preceding. A young man of twenty-four, working in a draughting office suddenly observed a mist over his right eye. As he could not find time for pilocarpine injections, he took granules of the same every night at bedtime, $\frac{1}{10}$ grain. Vision at first $\frac{5}{200}$, gradually increased, under the exhibition of pilocarpine, and the iodide in small doses, to $\frac{20}{40}$ and Snellen 8. Long words have to be spelled. No new formation in the vitreous. A long floating opacity in the vitreous. Left eye normal throughout.

Case 6.—Is the most remarkable that I have seen for many years, in that the patient had been treated, for nearly two years before he came under my care, with the iodide of potassium, mercurials, repeated and abundant leechings, Heurteloups to the temples, rest in bed, pressure bandages, pilocarpine injections, and even an iridectomy had been proposed for the condition diagnosticated in both eyes and that by several competent observers as a well-defined detachment of the retina.

April 10, 1891.—He was led into my office as he had to be led

into any room with which he was not familiar, although he can find his way about his own home. History: Age thirty-two. At the age of eleven, after a long attack of the measles followed with whooping-cough, it was discovered that his right eye was defective. He could see to read only the headings of newspapers. In June, 1889, the left eye suddenly failed. In one day the sight was so much reduced that he could only see the movements of his fingers. The eye was treated as above stated for eighteen months without the slightest improvement. In the interval, on the 30th March, 1890, the right eye, on which he had relied for some months for orientation and a small amount of farm work, failed as the other had done. The result was, that from that date till April, 1891, the amount of vision in each eye was the perception of the movement of the fingers in front of the eyes. When lying down, he could, on a very bright day, see people as they moved by the foot of the lounge on which he passed most of his time.

The green reflex plainly visible with the ophthalmoscope, the perfect field of vision, and the remembrance of the few other cases that I had seen, led me to tell him that there was no reason why he could not be made to see. Whereupon he told me what he had been doing for two years. Of course I felt rather dumbfounded on learning that he had taken all of the most approved remedies without avail. Nevertheless, knowing that the case could not possibly be one of detachment, and having great faith in the iodide of potassium in all stages of this new formation in the vitreous, he was directed to get a saturated watery solution of the iodide and to begin with small doses and increase to the largest that he could tolerate. He went as high as thirty drops three times a day, representing about 5 grms. In three weeks the sight began to improve. He continued the same medicine and has taken no other up to this date, February 16, 1892. He can see $\frac{20}{200}$ and Snellen 20, right, which is as good as before the late trouble. With the left eye he has S = $\frac{20}{40}$ and Snellen 6 with ease, except in the case of long words, which he has to spell, as he says he "cannot see all of the word at once." Vitreous clear in both eyes. Extending from each papilla, and embracing it, though not hiding it, is a green band, as nearly as I can express it, above and below, about one papilla diameter wide, and reaching out apparently over the retina about four disc diameters upward and three downward. With the refraction ophthalmoscope

the new formation or hyperplasia measures from +3 D to +5 D above the level of the rest of the retina. There are no vessels upon it. It looks somewhat like the doubled contoured fibres in Jaeger's Figure 36, but is distinctly green.

Not the least remarkable about this curious case is the fact that the iodide of potassium, which had been given in abundance before without any effect, should a year or two later act so efficaciously. This may be analogous to the fact that we often see one eye recovering from an attack of iritis, and the other just entering upon the same, despite the system being completely under the influence of mercurials, or of the iodide or other suitable remedies.

DIAGNOSIS.—It does not seem as if there were much if any need to insist that this disease ought not, under any circumstances, to be mistaken for a detachment of the retina. But I am convinced that many, if not all, of the reported cures of detachment of the retina after the use of pilocarpine are nothing but cures of vitreous hemorrhages. Even here we must not forget that, according to some authorities, spontaneous cure of these hemorrhages have been observed. So in the same way we may explain spontaneous cures of apparent detachment of the retina, as really nothing but the spontaneous disappearance of a vitreous hemorrhage. If, however, we are to insist on the diagnosis between hemorrhages and a detachment, it must be made on the basis of a perfect field of vision in the hemorrhage; and as the latter dissipates, the absence of the retinal vessels on the greenish bands, if such be present, as is oftentimes the case.

The PROGNOSIS seems to be favorable. No perfect restoration is possible, but useful vision is regained in a majority of cases. If a person has lost the sight of an eye from vitreous hemorrhage and yet recovers it so far as to be able to read Snellen 6 to 10, he has useful vision and could gain a living at many trades. If relapses occur, the chances may become worse. Only one patient complained of eccentric vision after slight restoration, but even that was soon remedied.

ÆTIOLOGY.—This remains in doubt. So long as we exclude all myopic eyes, and as we generally find the other eye, if

unaffected at first, apparently healthy, it would seem as if some strain, such as too violent exercise of the system, or the suppression of habitual discharges, or actual overwork of the eyes must be the exciting cause. In this respect the opinions of authors as before advanced in this paper may reasonably be consulted.

TREATMENT.—In the first place I should put hypodermatic use of pilocarpine hydrochlorate or nitrate. This is to be given in $\frac{1}{12}$ grain doses once a day for two weeks. Perhaps fewer doses may do as well. If any dose produces weakening effects on the heart then the next dose may be decreased, or omitted for two days. In case no visible effect is produced, the dose may go as high as $\frac{1}{6}$, though I have never seen the need of more than $\frac{1}{10}$. It is not necessary to produce visible physiological effects, for the remedy to be useful to the eye. It may also be given by the mouth, though it is not so efficacious when thus administered. The fluid-extract of jaborandi may be substituted, but it is much more disagreeable to take than the alkaloid.

Mercurials may be used in some cases, when the rarefication of the vitreous ceases from any cause. Inunction may be done by causing the patient to put a lump of blue mass into the stockings every day. Or blue mass and iron sulphate in equal parts in pill form may be used. Hypodermatic sublimate is occasionally indicated. It was substituted for the iodide in one case with apparently great benefit.

The constant current has been highly extolled by some, but the difficulty in keeping batteries in order where there is but little call for them will generally prevent its use in these as in other cases. In point of fact, two patients who do not appear in this list as they are still under treatment, have shown great improvement whilst using an ordinary faradic battery to each eye twice daily for five minutes.

Heurteloup's artificial leech is quite indispensable in the beginning of the attack. I never failed to advise its use. Care should be taken not to injure an artery. The application demands considerable skill on the part of the physician, but the reward is worth the time expended in doing the little operation neatly and with despatch.

RETENTION CYST OF THE CONJUNCTIVA OF TRAUMATIC ORIGIN.

By Dr. ENRIQUE LOPEZ, Habana.

Translated by Dr. C. E. Finlay.

THE case which I purpose to relate is, it seems, unique and interesting.

An injury from the horn of a cow produced a laceration of the soft parts around the eye, and a fracture of the internal, inferior and external portions of the margin of the orbit. The patient remembers being able to see with the eye immediately after the injury; but a violent inflammation set in, both lids became fastened together, and the cyst developed, without the patient's knowing whether he still had an eyeball or not, so that the discovery of the eyeball at the time of the operation was quite a surprise.

The piece of the cyst-wall which was extirpated, and which comprised the anterior and external portions, contained three fragments of bone in its interior. The cyst-wall was formed by the palpebral and retrotarsal conjunctiva; it was thick, unyielding, and firmly adherent to the neighboring soft parts.

Dr. Finlay, Sen., who made the histological examination, sends me the following report:

"The internal aspect of the cyst-wall is perfectly smooth. Remnants of epithelium are found on a more or less structureless, moderately thick basement membrane. The cyst-wall proper is extraordinarily thick, and is formed by a very dense network of connective tissue.

"The tissue of the cyst-wall merges into that of the neighboring soft parts without any special line of demarcation. Most

exteriorly one finds fatty tissue, and in some places striated muscle fibres."

The posterior wall was constituted by the cornea and bulbar conjunctiva. The cornea was perfectly transparent—the iris and pupil being plainly visible. The sclera could be seen through the bulbar conjunctiva. The eyeball had been pushed back into the orbit, and was fixed in the position of superior strabismus.

The contents of the cyst were a watery liquid, transparent and slightly yellowish. This fluid was not examined, all having escaped at the time of the operation. It probably was lachrymal fluid.

I consider the mode of formation of the cyst to be as follows: The traumatism produced lacerations of the conjunctival mucous membrane. Both the palpebral conjunctivæ wounded near their free border, adhered together and formed a cavity closed on all sides, and lined by the corneal and conjunctival epithelium. The tears filling this bag distended it and compressed the epithelial layer, which flattened out, the internal aspect of the cyst-wall becoming perfectly smooth, and the wall proper increasing in thickness. The conjunctival sac, once filled out, the retained tears compressed the lachrymal gland, and brought about its atrophy, or at least a considerable diminution in its secretory activity. In a word, the tumor which I describe, in my opinion, is nothing but a *retention cyst.*

CLINICAL HISTORY.

A laborer, twenty-four years of age, on being admitted to the Mercedes Hospital, relates that when a child both his eyes were healthy; that when twelve years old he received an injury from the horn of a cow in the left orbital cavity; that a violent inflammation set in, and that he was taken to the hospital of Ferrol (Spain), where he underwent an operation.

From that time a tumor commenced to form in this region, which has increased gradually up to its present size without causing any discomfort other than that produced by the deformity.

The tumor is conical on its anterior aspect, and is covered by the anchylosed eyelids, the free borders of which can only be separated about 4 *mm* from each other, through which small fissure one sees a band of red and thickened conjunctiva.

The tumor is fluctuating; the sensation on palpation being

that of a ball filled with fluid ; it is indolent ; there is no change in color of the skin of the lids. There is a diverticulum toward the lachrymal sac. Its limits within the orbit cannot be determined. The height of the cone is about 3 centimetres. Near the inferior and external orbital margin there is a sequestrum.

OPERATION.

The diagnosis of a serous cyst having been made, and under the supposition that there was no eyeball, I purposed to extirpate it entirely.

Chloroform ; division with a scalpel and a grooved director of the tissues joining the two lids ; the palpebral fissure being enlarged, both outward and inward. The lids were then separated from the cyst-wall with scissors and a grooved director. In cutting, the cyst was opened, giving exit to a yellowish, transparent fluid ; and at the bottom of the cyst-cavity the eyeball was discovered in a perfectly healthy condition.

The operation was finished by removing a portion of the anterior wall of the cyst, embedded in which were three pieces of dead bone, which had become separated from the orbital margin.

Sutures were then introduced to reduce the palpebral fissure to its normal size, and iodoform dressing was applied,

The following days there was only perception of light in the newly discovered eye, but at the end of a month the patient could count fingers.

SOME SQUINT STATISTICS.

By H. H. SEABROOK, M.D., New York,

SURGEON, NEW YORK EYE AND EAR INFIRMARY.

THIS study has as its basis the New York Eye and Ear Infirmary records of Dr. Chas. Stedman Bull, from 1876 to 1891. Intended originally merely for private information, it seemed probable that the results might prove interesting to ophthalmologists in general. Cases from Dr. Bull's later records, others from the records of Dr. M. E. Tully, and my own cases have been added, increasing the original number more than one fourth, but not affecting the general average to any extent. An attempt has been made to draw conclusions from these cases without reference to current views upon the subject, so far as possible.

STRABISMUS CONVERGENS.

(Physiological.)

The following are cases in which no lesion was known to exist in either eye. Cases of cured strabismus convergens, as well as secondary divergence following tenotomy of the internus, are included. There were in all 290 females and 249 males; many of these were children so young that no accurate study of their refraction and vision could be made.

Refraction.—For evident reasons only the cases under atropine are tabulated. On account of the intense spasm of accommodation so frequent in young subjects with internal squint, a distinction must be drawn between H T and H under atropine. Sometimes after an operation for the squint, or following the use of convex glasses, H M was

found to be greater than H under atropine had been. In such cases the higher H has been chosen as more nearly correct. In astigmatic cases the mean meridian is taken—H + ½ Ah in compound, ½ Ah in simple astigmatism.

TABLE I.

H OF STRABISMUS CONVERGENS UNDER ATROPINE

	Determined in one eye only.	Alike in both.	Differing in each	Totals.		
D 0.50			2	2	Under D 1.	
0.75		1	4	6		
1.			5	5	13	
1.25		7	8	22	D 1 to D 2.	Under D 2.
1.50	4	5	13	27		
1.75		1	3	5		
2.	5	1	19	26	80	93
2.25	1	2	5	10	D 2 to D 3.	Under D 3.
2.50	2	2	22	28		
2.75	2		7	9		
3.	3	7	19	36	83	176
3.25	2		8	10	D 3 to D 4.	Under D 4.
3.50	1	1	7	10		
3.75	1		3	4		
4.	2	4	27	37	61	237
4.25		2	3	7	D 4 to D 5.	Under D 5.
4.50	4	10	21	45		
4.75	2		3	5		
5.	7	2	20	31	88	325
5.25		1	2	4	D 5 to D 6.	Under D 6.
5.50		4	10	18		
5.75	2	1	5	9		
6.	1	1	13	16	47	372
6.25			1	1	D 6 to D 7.	Under D 7.
6.50		4	3	11		
6.75			1	1		
7.		1	3	5	18	390
7.50			2	2	Over D 7.	Total eyes
8.		2	1	5		
9.			2	2	9	399
Patients.....	39	59	121		Total . . 219	

Average refraction + D 3.67.

There were two cases of convergent squint and Am under atropine, although in one the refraction may be considered doubtful. In four cases M of high degree. Two of these had apparent convergence, periodically changing to real convergence. In one V O U $= \frac{4}{cc}$, with sph. — D 14 $= \frac{20}{cc}$, astigmatism by the ophthalmometer, with the rule, D 2.75. Jaeger No. 1 at $2\frac{1}{2}''$. Diplopia with the real convergence, M congenital or infantile, squint noticed recently.

As to whether the H of these squint cases is considered to be of high or low degree depends entirely upon the standpoint. For instance Donders says: "In general, it is not the highest degrees of H with which strabismus is combined . . . Where it was manifest, it amounted to from $\frac{1}{30}$ to $\frac{1}{10}$ rarely to $\frac{1}{7}$ or more . . . with $\frac{1}{30}$ manifest H more than $\frac{1}{15}$ total H may be assumed." Gould found in over 2,000 eyes HT averaging about D 1.50, counting the most hyperopic meridian in Ah. So it would seem that the standard at Utrecht thirty years ago differed from that more recently acquired at Philadelphia.

Two thousand eyes under atropine (1,028 patients) from Dr. Bull's clinical records, figured upon the same basis as the squint cases in Table I. gave average H = D 2.61. These cases with poor V, asthenopia or blepharitis counted in with the squint cases, give 2,399 eyes with average H = D 2.79. Consequently the 140 eyes in the table up to D 2.75 inclusive are below the hyperopic mean, while 259 are above it. And I should say: "In general *it is the higher degrees of H with which strabismus convergens is combined.*"

Vision.—The best V obtained by correction is shown in Table II. Where a second test showed a result markedly different from the first, the eyes were again tested and the correct V decided by weight of evidence.

The general decrease in V as H increases is here seen. The part astigmatism plays in defective V cannot be shown because of insufficient data in the earlier cases. At the bottom the 44 cases, refraction not determined, show how bad the V was when the patient was too young for proper correction, yet not too young to get a rough estimate of V. There was, in general, higher H by the ophthalmo-

scope in these than in the other cases, due no doubt to the fact that internal squint with good V in both eyes and moderate H is usually acquired after the beginning of school life, when the refraction can be obtained by testing the eyes with glasses. A comparison of the 255 eyes tested but once with the 399 tested two or more times emphasizes the fact that the more carefully the V is corrected the less "congenital amblyopia" there is.

Table II.

H and V of Strabismus Convergens under Atropine.

D	20 XX	20 XXX	20 XL	20 L	20 LXX	20 C	20 CC	less than 20 CC		Per cent. V
0.50		2							2	Under D 1.
0.75	3	2		1					8	
1.	2	1		2					13	.733
1.25	9	5	5	1	2				35	D 1. to D 2.
1.50	9	8	6	1		2	1		62	
1.75	4	1							67	
2.	4	7	7	2	5		1		93	.665
2.25	1	9							103	D 2. to D 3.
2.50	18	1	1	2	2	2	2		131	
2.75	4	3	1	1					140	
3.	13	6	5	6	4	1	1		176	.703
3.25	3	2	1	2	2				186	D 3. to D 4.
3.50	1	3		4	1		1		196	
3.75		2	1	1					200	
4.	8	7	8	5	6	1	1	1	237	.559
4.25	2	2	1		2				244	D 4. to D 5.
4.50	9	15	5	8	2	3	2	1	289	
4.75	2	1	1	1					294	
5.	4	7	4	8	4	3		1	325	.565
5.25		1	2				1		329	D 5. to D 6.
5.50		6	3	4	3		2		347	
5.75	2	1	1	2	1	1	1		356	
6.		6	2	2	2	1	2	1	372	.453
6.25					1				373	D 6. to D 7.
6.50		2		4	1		3	1	384	
6.75			1						385	
7.		2	1	1	1				390	.383
7.50					2				392	Over D 7.
8.		1		3		1			397	
9.							2		399	.315
Totals	98	103	56	61	41	15	20	5	399	.592
Average H	D2.64	3.59	3.54	4.27	4.16	4.22	4.97	5.20		
V Atropine. Refraction unknown.	3		1	2	4	4	10	20	44	
V No atropine	60	46	33	31	25	18	17	25	255	
V Totals.	161	149	90	94	70	37	47	50	698	

As regards the question of "Anisometropia Hypermetropica" as a cause of squint, the following is submitted: Over 40 per cent. of the 1028 cases before mentioned had a different degree of H in the right from that in the left eye, this difference occurring mostly in the higher degrees of H. Among the converging eyes V being known in both eyes of 343 patients, there were with V and refraction the same in the right and left eyes, $\frac{20}{XX}$, 19; $\frac{20}{XXX}$, 18; $\frac{20}{XL}$, 10; $\frac{20}{L}$, 10; $\frac{20}{LXX}$, 2; $\frac{20}{C}$, 1; $\frac{20}{CC}$, 2; a total of 62 cases, while 31 had equal V in both eyes, refraction differing as follows: $\frac{20}{XX}$, 11; $\frac{20}{XXX}$, 10; $\frac{20}{XL}$, 5; $\frac{20}{L}$, 3; $\frac{20}{LXX}$, 2, making 93 cases with V the same in both eyes, only 7 with $\frac{20}{LXX}$ or less. The V differed, but refraction of the right and left eyes was the same in 24 cases, making 86 cases with refraction the same in both eyes.

Perhaps these figures prove something, yet I cannot say that I know just what. The data are given, because of the interest upon this point displayed by certain ophthalmologists, who seem to consider it of great importance.

The following cases are those which I have tested within two years: In case No. 1 the eyes were tested once, the left not improved, and a diagnosis of congenital amblyopia made yet corrected V = $\frac{20}{XX}$. Unusual care was taken after this to ascertain the refraction of squinting eyes with defective V, the test glasses and atropine being mainly relied upon, with the ophthalmoscope and later the ophthalmometer as auxiliaries. The later results were by far the more satisfactory, as the ciliary muscle is really paretic in many of these eyes, although the other eye, with better apparent V and less squint, may have considerable spasm of accommodation. If the proper correction is not put upon the weaker eye at first, the eye or the patient becomes rapidly fatigued, and the result is much less satisfactory.

The later cases were tested as follows: The V of the more defective eye was first taken; then the V of the other, in order to eliminate alphabetical recitations from memory,

which otherwise might interfere with the test. H in the meridian of least curvature was then measured with the ophthalmoscope; afterwards the astigmatism with the ophthalmometer. The correction thus obtained was put upon the eye, and in many cases was found to be the best obtainable, although variations were tried. It will be seen by the tests how often and how much the V was improved. The corrected V was always verified with a fresh test-card, and the better eye held shut by the hand of the patient while the other was tested; this not only to avoid error, but to enable the open eye to fix better, so as to more accurately obtain the V at the macula. In some the correction of the astigmatism gave no better result than the spherical glass alone, yet was accepted, the patient even claiming to see more distinctly with the cylinder added. In such cases the cylinder is enclosed in brackets in the list of cases. Where a glass was accepted without improvement, V is given unimproved; V given as do. meaning that the V dropped under atropine, to be brought back to the original V by means of the given glass. A spherical, estimated, means, where the diagnosis of astigmatism is given, in the least meridian of H. Macula Cases 52 and 63 are not in Table I, but among the pathological cases.

No.	Age.	Eye.	V.	Corrected V.	Correcting Lens.	V Other Eye.	Corrected V.	Correcting Lens.	Remarks.
1	16	L	20/C	20/XX	Sph. + D 3.75 ⊂ Cyl. + D 1.50 axis 90°	20/XXX	20/XX	Sph. + D 4 ⊂ Cyl. + D 1.50 axis 90°	Homonymous diplopia. Insufficiency of left superior rectus.
2	11	R	20/XL	20/XXX	Sph. + D 1 ⊂ Cyl. + D 1 axis 180°	20/XXX	do.	Sph. + D 1 ⊂ Cyl. + D 1 axis 180°	
3	7	R	20/LXX	20/XXX	Sph. + D 4	20/XXX	do.	Sph. + D 4	
4	11	R	20/C	20/XL	Sph. + D 4 ⊂ Cyl. + D 2.25 axis 105°	20/C	20/XXX	Sph. + D 4 ⊂ Cyl. + D 2.25 axis 75°	
5	14	R	5/CC	20/L	Sph. + D 3 ⊂ Cyl. + D 3 axis 90°	20/XL	20/XXX	Sph. + D 4	
6	15	R	20/C	20/LXX	Sph. + D 5	20/XL	20/XXX	Sph. + D 5 ⊂ Cyl. + D 1.25 axis 90°	
7	12	R	20/CC	20/L	Sph. + D 8	20/C	20/L	Sph + D 8	H + Ah.
8	16	R	20/CC	20/L	Sph. + D 1.50 ⊂ Cyl. + D 4.50 axis 90°	20/XXX	do.	Sph. + D 1.25	R E improved without atropine.
9	8	L	20/C	20/L	Sph. + D 3	20/CC	Unimproved		With ophthalmoscope H = D 4 50.
10	10	R	20/C	20/L	Sph. + D 1.75	20/L	Unimproved		No atropine.
11	15	R	10/CC	20/C	Sph. + D 3.50	20/XL	do.	Sph. + D 1.50	No atropine.
12	12	R	20/CC	20/LXX	Sph. + D 2.50	20/XX	do.	Sph. + D 2.50	No atropine O D.
13	13	R	20/XL	20/XXX	Sph. + D 1.25	20/XX	do.	Sph. + D 1	Test of 1883, operation, then V O D = 20/XXX V O S = 20/XX
	21	R	20/XX	do.	Sph. + D 1.50	20/XX	do.	Sph. + D 1.75	Insufficiency of interni. *Homonymous* diplopia, fused by prism of 10° base in. Field of vision normal O. U.
14	11	L	20/CC	20/L	Sph. + D 3.50 (Sph + D 4 (est.)	20/C	20/L	Sph. + D 3.50 (Sph. + D 4 (est.)	Convergent squint in family for six generations. Operation (tenotomy right internus), then O S parallel with O D for distance. Converges when O D fixes near point.
	11½	"	"	"	Sph. + D 4.50 (Cyl. + D 0.50 axis 90°	"	20/XXX	Sph. + D 4.50	
15	8	R			Sph. + D 3 (est.)			Sph. + D 4 (est.)	
16	11	R	20/XXX	20/XX	Sph. + D 2.75 ⊂ Cyl. + D 1 axis 90°	20/XXX	20/XX	Sph. + D 4.	Double tenotomy four months later; tenotomy right internus one month after this. Result: O D converges on fixation for near point; parallelism for distance.
17	5	R			Sph. + D 4 (est.)			Sph. + D 4 (est.)	Weak externi.
18	8	R	2/CC	Unimproved	Sph. + D 7 (est.)	?	20/XXX	Sph. + D 4.50 ⊂ Cyl. + D 1.50 axis 90°	H + Ah O D.
19	7	R	6/CC	20/C	Sph. + D 7 ⊂ Cyl. + D 2 axis 60°	20/L	20/XXX	Sph. + D 7 ⊂ Cyl. + D 2 axis 120°	
20	17	L	20/L	do.	Sph. + D 6.50	20/XXX	do.	Sph. + D 6.50	Insufficiency of interni; convergence disappeared in two months under Sph. + D 5.
21	6	L	20/CC	Unimproved		20/LXX	do.	Sph. + D 5	

No.	Age.	Eye.	V.	Corrected V.	Correcting Lens.	V Other Eye.	Corrected V.	Correcting Lens.	Remarks.
22	20	R	6/CC	20/LXX	Sph. + D 3.50 ⌒ Cyl. + D 1.50 ax. 45°	20/C	20/L	Sph. + D 4 ⌒ Cyl. + D 2 axis 135°	
23	10	L	2/CC		Sph. + D 2 (est.)	20/XX		Sph. + D 1.50 (est.)	Estimated under atropine; nasal side of disk hazy and indistinct. Lenticular astigmatism or neuritis?
24	15	R	20/CC	Unimproved		20/XX	do.	Sph. + D 2.75	
25	13	R	20/C	20/XL	Sph. + D 8	20/XL	20/XX	Sph. + D 6	
26	7	L	10/CC	20/CC	Sph. + D 9	20/XXX	do.	Sph. + D 6	
27	15	L	20/XXX	20/XX	Sph. + D	20/XX	do.	Sph. + D 4	Homonymous diplopia. Parallelism with glasses in one month.
28	7	L	90/LXX	90/XL	Sph. + D 4	20/LXX	do.	Sph. + D 5.50 ⌒ Cyl. + D 1.50 axis 90°	
29	7	L	20/C	20/LXX	Sph. + D 7 ⌒ Cyl. + D 1 axis 90°	20/XL	do.	Sph. + D 7	
30	7	L			Sph. + D 3 (est.)			Sph. + D 2.50 (est.)	H + Ah O S.
31	4	L			Sph. + D 4.50 (est.)			Sph. + D 3.50 (est.)	H + Ah O U.
32	10	L	20/C	20/XX	Sph. + D 3.25 ⌒ Cyl. + D 2.50 axis 115°	20/XL	20/XX	Sph. + D 2.50 ⌒ Cyl. + D 1.75 axis 80°	Operation sixteen months before.
33	5	L			Sph. + D 5.50 (est.)			Sph. + D 4 (est.)	
34	12	L	2/CC	Unimproved	Sph. + D 6 (est.)	20/L	do.	Sph. + D 5	Faint striæ in lens O. S.
35	7	L	20/C	20/LXX	Sph. + D 6	20/XL	20/XXX	Sph. + D 5	
36	18	L	20/XL	20/XX	Sph. + D 5.50 ⌒ Cyl. + D 1.25 axis 120°	20/XX	do.	Sph. + D 5 ⌒ Cyl. + D 1.50 axis 90°	
37	6	R			Sph. + D 4.50			Sph. + D 4.50	Estimated under atropine.
38	7	R			Sph. + D 3.50			Sph. + D 3.50	Estimated under atropine.
39	6	R			Sph. + D 2 ⌒ Cyl. + D 3 axis 110°			Sph. + D 2 ⌒ Cyl. + D 3 axis 90°	Ophthalmoscope and ophthalmometer.
40	9	L	20/XL		Sph. + D 2.50	20/XX		Sph. + D 1.50	Ophthalmoscopic approximation.
41	13	L	20/CC	20/XL	Cyl. + D 5, axis 60° ⌒ Sph. + D 4	20/XL	20/XX	Cyl. + D 3.50 axis 150° ⌒ Sph. + D 2.50	
42	14	R	20/CC	20/C	Cyl. + D 6 axis 105° ⌒ Sph. − D 1.50	20/XL	do.	Cyl. + D 4 axis 105° ⌒ Sph. + D 3	Operation five years before. Marked internal squint at present.
43	9	L	3/CC		Sph. + D 6 (est.)	20/CC		Sph. + D 3 (est.)	
44	7	R	20/CC		Sph. + D 5.50 (est.)	20/LXX		Sph. + D 3.50 (est.)	
45	11	L	15/CC	20/LXX	Sph. + D 8 (Cyl. + D 1 axis 120°)	20/XX			No atropine. O D hyperopic.
46	19	R	20/CC	20/C	Sph. + D 3.50 ⌒ Cyl. + D 3 axis 90°	20/L	20/XXX	Sph. + D 8 ⌒ Cyl. − D 1 axis 30°	
47	12	L	20/CC	20/L	Sph. + D 5 (Cyl. + D 2.50 axis 120°)	20/XX	do.	Sph. + D 4.50	

No.	Age.	Eye.	V.	Corrected V.	Correcting Lens.	V Other Eye.	Corrected V.	Correcting Lens.	Remarks.
48	7	L	$\frac{20}{C}$	do.	Sph. + D 4 (Cyl. + D 3.75 axis 75°)	$\frac{20}{L}$		Sph. + D 3 ⌒ Cyl. + D 2.50 axis 120°	V O D before atropine = $\frac{20}{L}$. After atropine = $\frac{20}{CC}$. With lens given = $\frac{20}{LXX}$
49	10	R	$\frac{8}{CC}$	$\frac{20}{CC}$	Sph. + D 6.50	$\frac{8}{CC}$	$\frac{20}{CC}$	Sph. + D 6 50	H + Ah O U.
50	3	L			Sph. + D 7			Sph. + D 6	Estimated. Child is wearing Sph. + D 4 O D Sph. + D 6 O S.
51	11	R	$\frac{20}{XX}$	do.	Sph. + D 2.50	$\frac{20}{XX}$	do.	Sph. + D 2.50	
52	12	L	$\frac{1}{CC}$	Unimproved		$\frac{20}{XX}$	do.	Sph. + D 2.75	Macula corneæ; strabismus sursumvergens O S. Slight convergence only left after tenotomy and correcting glass.
53	29	L	$\frac{6}{CC}$	$\frac{15}{CC}$	Sph. + D 5.50 ⌒ Cyl. + D 2.50 axis 90°	$\frac{20}{XV}$	do.	Sph. + D 0.75 ⌒ Cyl. + D 1 axis 75°	Tenotonomy left internus eight years before; perfect parallelism. No glass worn.
54	17	L	$\frac{20}{CC}$		Sph. + D 4 ⌒ Cyl. + D 2.50 axis 90°	$\frac{20}{XX}$		(Sph. + D 4)	
55	15	R	$\frac{20}{CC}$	$\frac{20}{LXX}$	Sph. + D 7	$\frac{20}{LXX}$	$\frac{20}{L}$	Cyl. + D 1.75 axis 180°	
56	14	L	$\frac{20}{XXX}$	do.	Sph. + D 3.50	$\frac{20}{XX}$	do.	Sph. + D 3.50	No atropine. After operation.
57	18	L	$\frac{20}{C}$	$\frac{20}{XXX}$	Cyl. + D 2.50 axis 150°	$\frac{20}{XX}$	do.	Sph. + D 1.50	Tested under atropine by my assistant, Dr. Burnham, who found H O D = D 5, but did not correct O S. Test here given is the third, practically agreeing with first. No atropine.
58	12	R	$\frac{20}{L}$	$\frac{20}{XXX}$	Cyl. + D 1 axis 90°	$\frac{20}{XXX}$	$\frac{20}{XX}$	Cyl. + D 0.75 axis 165°	
59	20	L	$\frac{20}{L}$	do.	Sph. + D 1.25 (Cyl. + D 1 axis variable)	$\frac{20}{XX}$	do.	(Cyl. + D 0.50 axis 60° ⌒ Sph. + D 0.50)	O S formerly converged. Tenotomy internus three years before. Parallelism at first (patient's statement). O S now diverges. After atropine *convergence* O U. Ophthalmometer shows: O D astigmatism D 0.50 axis 60° centre of pupil; just to either side D 1 axis 90°. O S. Two meridians of curvature (+ D 0.50) crossing line an X, and sharply defined.
60	11	R	$\frac{20}{L}$	$\frac{20}{XXX}$	Sph. + D 3	$\frac{20}{L}$	$\frac{20}{XL}$	Sph. + D 3.50	Squinted up to about five years of age. Spontaneous recovery. Has worn glasses over one year for asthenopia. No atropine.
61	8	R	$\frac{20}{XXX}$	do.	Sph. + D 4	$\frac{20}{XX}$	do.	Sph. + D 3.50	Squint recently acquired.
62	8	L	$\frac{3}{CC}$	$\frac{20}{CC}$	Sph. + D 4.50 (Cyl. + D 2 axis 135°)	$\frac{20}{L}$	$\frac{20}{XL}$	Sph. + D 3 (Cyl. + D 1.50 axis 90°)	
63	33	L	$\frac{3}{CC}$	Unimproved	Sph. + D 5 (est.)	$\frac{20}{C}$	$\frac{20}{XL}$	Sph. + D 5.50	Operation for squint O S years before. Result good — not perfect. No glasses worn. No atropine. Small macula corneæ *O D.*

These cases emphasize in a marked manner the results shown in Table II. Briefly stated, so-called congenital amblyopia is ametropia. Counting H + Ah in the above cases, the eyes with V before correction = $\frac{20}{Lxx}$ or less average well over D 6, and the more sure the correction the higher the H + Ah.

When V can not be satisfactorily corrected, one of the following causes can usually be demonstrated: 1. A high degree of astigmatism, with the axis diagonal. 2. Astigmatism, meridians of greatest and least curvature not at right angles. 3. Irregular corneal astigmatism, and of this there are many varieties. 4. Lenticular astigmatism. When we add to these other possible causes of defective V, such as improper centring of the cornea or lens as regards the axis of vision, there is little need to fall back upon defective retinal development as an explanation of poor V in these cases. The ophthalmoscopic signs by which congenital amblyopia is diagnosed would seem to be due to ametropia, for they are in great part absent where V is defective, and H is not of high degree just where their presence would be most useful and suggestive, and high degrees of H in which they are present can sometimes be markedly improved with a glass. V of eyes, with moderate errors of refraction and healthy media and fundus, varies from $\frac{20}{xxx}$ to $\frac{20}{x}$, and such good V is not expected from the correction of the higher refractive errors.

Eyes with defective V usually do not squint. Fifteen years' clinical records show among the hyperopic eyes, with V $\frac{20}{Lxx}$ or less:

EYES WITH CONVERGENT SQUINT.	EYES WITHOUT SQUINT.
158.	246.
Under atropine, 93.	Under atropine, 139.
Average H = D 4.23 in 56 corrected under atropine.	Average H = D 3.91 in 122 corrected under atropine.
Average H = D 4.07 in 47 with V = $\frac{20}{L}$ or better; the other eye with less V.—Under atropine.	Average H = D 2.83 in 64, with V = $\frac{20}{L}$ or better; the other eye with less V.—Under atropine.

Comparison of these eyes with defective V, with and without squint, has shown me but one difference between them. In the squinting eye H, in the normal axis of V, is sometimes of higher degree than in the acquired axis in the squinting position. So far I have not seen an eye without squint in which eccentric V was even apparently better than central. Defective V at the macula has been considered by competent observers as a peculiarity especially pertaining to squinting eyes, and I have come to consider it as a factor in the causation of squint.

STRABISMUS CONVERGENS.

(*Pathological.*)

Records of over fifty cases are at hand. In some it is certain that the squint antedated the pathological condition. It is not necessary to mention these in detail, although it is highly probable that the following list contains a number of cases where investigation would show the disease to be a complication rather than a cause of the squint.

Macula Corneæ.—Including 1 case of old pannus, there were 18 cases with corneal macula. In 7 of these the refraction is not noted. In 1, nineteen year old, V O D $= \frac{20}{xx}$; V O S $= \frac{20}{cc}$ with cyl. — D 3.50; axis 180°; macula, O S; squint, OU. Another, V O D $= \frac{20}{L}$; leucoma adhærens; V O S $= \frac{5}{cc}$, with sph. $- \frac{1}{18} = \frac{20}{cc}$; macula corneæ and strabismus convergens. In 9 cases (13 eyes) the refraction was hyperopic, averaging D 4. Whether the position of the macula had anything to do with the determination of the character of the squint, I do not know in most of the cases, but can positively answer, as regards several, that it had not, the opacity not being upon the pupil, although irregular corneal astigmatism may have encroached upon the pupillary region.

There was 1 case of macula, cataract, and H in addition to the above.

Cataract.—There was H in 2 cases of cataract and convergent squint, with nystagmus in 1 of these; M in 4; choroidal atrophy, with nystagmus, in 1; refraction not determined in 1.

Nystagmus.—Of the nystagmus cases not mentioned above, there was H in 3; refraction not determined in 1.

Atrophy of optic nerves or choroid, 5 cases. In 1 there was M of low degree; in another H.

Leucoma adhærens, *phthisis bulbi*, *irido-choroiditis*, and *following traumatism to eyeball*, 8 cases. This exclusive of the case under macula corneæ, the other eye in these cases being hyperopic, so far as is known.

Associated with other deformity, 3—coloboma iridis, 1; cleft palate, 1; tumor of orbit, 1.

One case seems to me so significant that I give a brief history:

A man, aged forty-one, with convergent strabismus, senile cataract almost mature, paralytic external recti, facial palsy, V O D = $\frac{3}{cc}$, V O S = $\frac{1}{cc}$. The squint dates from infancy, and V O S has been defective from earliest remembrance. The facial palsy occurred during childhood. Progressive failure of V O U, for two years. The cataract was extracted later, from the left eye; ten months afterward from the right. V O D, one month after operation = $\frac{20}{L}$, with sph + D 10; V O S, eleven months after operation = $\frac{20}{xxx}$, with sph + D 10.

This case certainly looks like "congenital amblyopia" from lenticular, or possibly corneal, astigmatism, and the history is decidedly against defective retinal development or disuse as a cause of the original defective vision in the left eye.

STRABISMUS DIVERGENS.

The most concise method of presenting the statistics upon this subject appears to be by means of a table, which it is to be hoped will explain itself, as probably no one will care to take the trouble to explain it:

STRABISMUS DIVERGENS.

	Hyperopia.	Myopia.	Mixed astigmatism and anisometropia.	Emmetropia and refraction unknown.	Total.
Physiological	34	21	2	8	65
Choroidal atrophy		8		2	10
Macula corneæ	1	8	1	9	19
Atrophy of optic nerve		8		10	18
Cataract (senile)	1	1		11	13
Cataract (traumatic)	1			4	5
Membrane, or connective tissue in vitreous		1		1	2
Nystagmus	1	1		1	3
Following disease of iris, injury to globe, etc	3	4		5	12
With acute choroidal or retinal disease		2		2	4
Following general disease				2	2
Totals	41	54	3	55	153

The number of cases of H treated at the New York Eye and Ear Infirmary is more than double the number of cases of M. Parents bring children with squint to be treated, and the refraction in these cases is usually hyperopic. Divergent squint with M is usually acquired, and adults who are "wall-eyed" consider the deformity much less of a blemish than "cross-eye," and the slight consideration of the "beam in their own eye" is fostered in some cases by the fact that the eyes can be brought parallel long enough to observe an image in the mirror. Consequently, patients with divergence apply less often for treatment. Yet the facts remain that H and divergence are associated with more frequency than is generally supposed (see Nemier, *Recueil d'Oph.*, April 1890), that the myopic cases are usually associated with disease (if decided choroidal atrophy with greatly diminished V be counted with the other diseases), and that good V in both eyes is far less frequent in strabismus divergens than in strabismus convergens. In the former 1 case of Em and 2 of M of low degree had $\frac{20}{xx}$ OU; 3 of H, 1 with Am and 1 with irregular corneal astigmatism, had $\frac{20}{xxx}$ OU. Of the

other cases with known V, or lack of V, 20 were absolutely blind, while 45 others had V of $\frac{5}{cc}$ or less.

The influence of the refraction in the production of squint is involved in some obscurity. Among the 55 cases with divergence, classified as "emmetropia and refraction unknown," were many with $\frac{20}{xx}$ or $\frac{20}{xxx}$ vision in at least one eye which would no doubt have shown some H under atropine, while not one appeared to be myopic. Paralyses of the ocular muscles are of course not included among the cases treated of in this paper, as the term is ordinarily understood, yet essential muscular defects were frequent even in concomitant strabismus convergens. It will be seen that chronic diseases known to markedly affect central vision are frequently associated with squint, while not one case of chronic glaucoma appears in the list.

CONTRIBUTIONS TO CLINICAL OPHTHALMOLOGY: BEING GLEANINGS FROM MY CASE-BOOKS.

By SWAN M. BURNETT, M.D., Ph.D., Washington, D. C.

(*With eight illustrations.*)

MUCH valuable clinical material embodied in the histories of cases has been allowed to run to waste, because the observers did not deem the peculiarities or interesting features of sufficient importance to form the subject of a separate article for publication. It may have been that those points which attracted the attention of the observer were only single features of otherwise ordinary cases, and it was a question as to whether, after all, these features would be of the same interest to other practitioners; or it may be that they were of such a character as to be merely uncommon or *bizarre*, without any direct reference or suggestion as to pathology or therapeutics. And yet such cases may hold the key that is to unlock some of the treasures of knowledge still hidden from us. We are not yet in the position to ignore isolated facts seemingly small or insignificant; and there is not a single question in the whole range of ophthalmological studies in regard to which the final word has been said, and in respect to which some knowledge is not desirable; and it has seemed to me that if practitioners of experience were, from time to time, to publish a collection of such cases, recorded in a succinct manner, as have been interesting or novel in their eyes, we would be likely to find among them some nugget of knowledge which would be an addition to the golden granary of

ophthalmological science. With this opinion, then, I feel that no apology is necessary for offering the following cases for the perusal of my fellow-practitioners, premising only, in answer to a possible criticism, that I have considered that those cases which held sufficient interest for me to cause me to report them, would not be without an interest likewise to, at least, some others to read. No attempt has been made to go into the literature of the different subjects suggested by the clinical histories, and they are submitted simply as gleanings from my case-books.

Case I.

RETRO-BULBAR NEURITIS, WITHOUT DISCOVERABLE CAUSE; MARKED SHOT-SILK RETINA; CENTRAL SCOTOMA FOR RED; PECULIAR VISUAL FIELDS.

Webster Burke, a strong, healthy negro boy, was seen at my clinic for the first time October 15, 1887. He was then fifteen years old. He had first noticed a failure of vision about a month before. There was no history of any disease, and the only thing

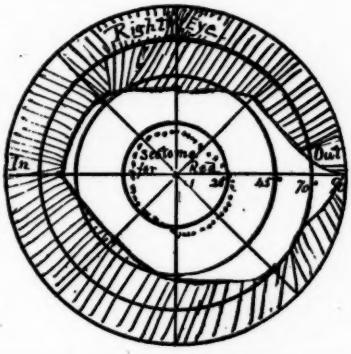


FIG. 1.—Visual field of Webster Burke.

he had to offer in explanation of his trouble was a blow on the left cheek some six months previously. There was nothing at the time of this examination to account for the bad vision, which was only $\frac{3}{60}$ in either eye. The so-called "shot-silk" appearance of the retina was as pronounced as I have ever seen it,

though it is very common in the negro race. The ophthalmoscope showed him to be emmetropic, and the disk normal. As there were no general symptoms of any kind, he was treated expectantly. He reported at the clinic regularly for some months, during which time there were no changes, and was then lost sight of until November, 1891, when he again presented himself, and was thoroughly examined. His vision is now $\frac{5}{60}$ in either eye. The visual fields are peculiar. They are approximately normal, as to outer limits for white, as shown in the diagram, Fig. 1, and also for red and blue. Green he cannot distinguish at all, calling it always brown in every part of the field. There is a central scotoma for red in each eye, which is nearly circular, extending from 15° to 25° from the point of fixation. Inside of this limit he says that the red looks dark, but of no definite color. The patient is an intelligent boy, and neither drinks nor smokes. Very marked changes, however, have taken place in the optic nerves since the first examination. Both disks are now white, and slopingly excavated. There is no material change in the size or number of the retinal vessels, except that there are scarcely any capillaries on the surface of the disks. The shot-silk appearance continues the same.

The interest in this case consists, first, in the obscurity of the cause of the nerve atrophy. It was caused undoubtedly by a post-ocular neuritis, and began most probably behind the chiasma, but so far as we can rely upon the absence of symptoms it was an isolated pathological process. It is hard to conceive of the blow he received as having a causative connection with the atrophy since this was bilateral, unless we suppose a fracture of the *sella turcica*. Secondly, the visual fields are peculiar. To find an approximately normal field for white in such an atrophy and with such a low central vision, cannot be common. In addition, we have a field for red of normal extent, but with a central scotoma quite clearly defined, and an inability to distinguish green in any part of the field; but normal fields for blue and yellow.

How far the SHOT-SILK OR WATERED-SILK APPEARANCE OF THE RETINA is a pathological condition it is hard to say. I have attempted to give some idea of its appearance in the

drawing, Fig. 2. The whitish streaks are seldom seen along the sides of the vessel unbroken for any considerable distance, and their position changes with the slightest change in the position of the mirror. It can be seen to advantage only in the erect image. You quite frequently get a shimmer from the surface of the retina itself, independent of the vessels. Sometimes a small vessel seems to be broken up into a series of beads, and the vessels appear to be broadened at places. But the most remarkable change is in the macular

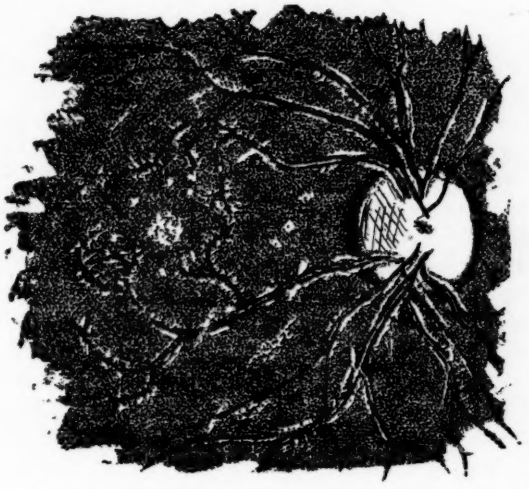


FIG. 2.—"Shot-silk" retina and white atrophy of the optic nerve.

region. Here, directly over the fovea, there is a spot having a diameter about equal to that of three veins of the first magnitude, of an irregular circular form, whose outlines are constantly changing with the slightest movement of the eye or the mirror. This must not be confounded with the halo around the macula which is so frequently seen in dark fundi particularly, though it seems to me that they both depend upon the same cause, namely, reflection from the hyaloid membrane. I have frequently seen it, however, on a small scale, in persons with much pigment directly at the yellow

spot. The reflex alongside of the vessels can be seen faintly on the surface of the white disk, but the width of the vessel itself appears much less on the disk than after its passage over on to the retina.

The most satisfactory explanation of this shot-silk appearance that I can offer is a thickening and opalescence of the hyaloid membrane, and I am disposed to regard it as pathological, or at least abnormal. In a recent paper on the ophthalmoscopic appearances in hypermetropia in the *Ophthalmic Review* for November, 1891, Mr. Bristowe offers the suggestion that the reflex which is more or less marked in certain cases of hypermetropia associated with arrested development, is due to a striated condition of the ganglionic cells of the retina, which remains over from the embryonal state. This view, it seems to me, is negatived by the fact that the appearance along the vascular walls is continued quite perceptibly on to the disk surface, where, of course, there are no ganglionic cells. The appearance which Loring speaks of on page 64, vol. i., of his text-book, is not the same as this, and is correctly, I think, accounted for by him as being due to increase of the normal connective tissue. That this appearance has any important connection with the nerve trouble in this instance we cannot say with positiveness, but I have one case in mind of a girl who has a low visual acuteness with emmetropia, in whom such a shot-silk appearance is very pronounced. In another case of a negro girl of ten there was associated with the shot-silk appearance a very contracted visual field in both eyes, most pronounced in the left. Her vision in this eye was $\frac{5}{1\frac{5}{7}}$, in the right $\frac{5}{5}$, and the failure in vision was said to have been noticed after an attack of measles four years before.

Case II.

CYST OF THE IRIS.

John H. D., colored, aged thirty-five, was seen by me for the first time July 18, 1885. He stated then that eleven years before he had been struck on the right eye by a bit of steel, which cut the eyelashes and penetrated the cornea, carrying some of the lashes with it. The steel and, as he supposed, all of the hairs were

removed by Dr. Bacon of New Haven, where the accident occurred. The lens was gone, and some capsule still remained in the pupillary space, which latter was drawn into the cicatrix. A CILIUM was SEEN LYING IN THE ANTERIOR CHAMBER as shown in the diagram c, Fig. 3. He can barely see his way

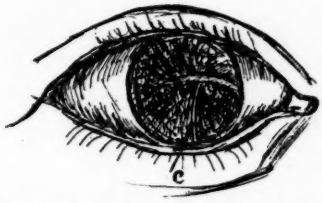


FIG. 3.—Cilium (C) in the Anterior Chamber.

about (the other eye was blind from optic atrophy following orbital cellulitis, an account of which I published in the ARCHIVES OF OPHTHALMOLOGY, 1885, p. 177).

On the 28th of September, I opened the anterior chamber, took out the cilium, and removed a piece of the iris, up to the dotted line of the drawing, Fig. 3. A discision of the opaque capsule was made later, which freed the pupil from the cicatrix, and with + 12 his vision was $\frac{4}{18}$. I saw him no more until February 18, 1887, when he came complaining of pain, which had begun about three weeks before, and a diminution of vision. I found some slight injection of the conjunctiva, and a state of things represented in Fig. 4. The lower and outer portions

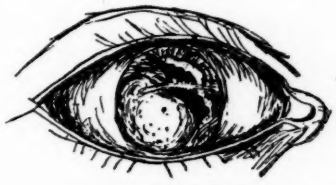


FIG. 4.—Cyst of the Iris.

of the anterior chamber were filled with a smooth clearly outlined body which looked not unlike a dislocated lens, whose surface was dotted with points of pigment. The lens being absent, I made the diagnosis of cyst of the iris. He was sent to Garfield Hospital, and on the 25th I made an incision with a triangular

knife below, evacuated the cyst, and attempted to remove the walls, but after the collapse they could not be identified. The piece of iris which appeared to contain the base of the cyst was cut off. The patient made a good recovery and saw fairly well. Eighteen months later there was no return of the cyst.

Case III.

LOSS OF EYE IN EARLY LIFE FROM INFLAMMATION (TRAUMATIC); SYMPATHETIC IRIDO-CHOROIDITIS MANY YEARS AFTER; ENUCLEATION OF THE ATROPHIC BALL; RELIEF TO THE IRIDO-CHOROIDITIS; FORMATION OF BONE IN THE VITREOUS OR RETINA, SPRINGING FROM THE OPTIC DISK.

It is much to be regretted that the detailed history of this case, taken during the patient's stay in the hospital, has been misplaced and cannot be found. As, however, its chief value lies in the pathological condition of the enucleated eye, I think it may not be without interest to give the general outlines of the clinical history as I remember it, to accompany the drawing of a section of the eye.

The patient was a mulatto, twenty-eight years old when he was admitted to Garfield Hospital in 1885. He was at that time suffering from an intense irido-choroiditis in the *left* eye, and had been for many weeks. He had had recurring attacks of inflammation in that eye for eighteen months or more, for which he had been treated by a surgeon, who, however, had never suggested the removal of the *right* eye, that had been lost in early life from an inflammation which he thinks began after an injury. The *right* eye was not inflamed, nor had it been for a very long time. It was quite hard, but there were no points sensitive to the touch. It was smaller than the other eye; the cornea was quite clear; the pupil closed, and the anterior chamber shallow. I advised the removal of the lost eye as the first step in the treatment, and it was readily assented to and done. Within forty-eight hours there was an amelioration in the intensity of the irido-choroiditis, which went steadily on to complete disappearance of pain and inflammation in the course of four weeks. Vision was very much impaired, and he was barely able to see his way about when he left the hospital. He has not been heard of since.

The eyeball, when opened by a cut at the equator, was found to contain a nearly globular mass, as hard as a bone, and it

seemed attached to the posterior pole of the eye. It was hardened in Müller's fluid, and in due time, after decalcification, some beautiful sections through the entire globe were made by Dr. Gray at the Army Medical Museum. A drawing of one of these sections through the optic nerve is given in Fig. 5. There is a mass springing from the optic-nerve entrance which contains what are undoubtedly the elements of bone, and between the Haversian canals there are the distinctive cells of adipose tissue. The lens has disappeared, but the anterior capsule remains. There are bands of pigment running down from the ciliary body towards the neoplasm, but do not reach it. There are a few pigment

FIG. 5.—Formation of bone in the eye, starting from the optic-nerve entrance.

granules near the apex of the bony mass, otherwise it is free. The sections showed the mass to be a solid, and not a shell, and it touched the walls of the globe at no place except the optic-nerve entrance.

Clinically this case is of interest as another instance of sympathetic ophthalmia setting in many years after the loss of the fellow-eye; for that the irido-choroiditis was sympathetic can hardly be doubted, since it began to improve immediately upon the removal of the degenerated ball; and had the surgeon who saw him in the first place removed the offending cause, that would have ended the whole trouble, and the vision in the remaining eye would have been saved. It also substantiates the opinion that intra-ocular bony formations always, in time, bring about sympathetic trouble in the other eye. Such cases tend to deepen rather than to clarify the mystery of the pathogenesis

of sympathetic troubles generally, though this particular case would seem to support the migratory theory, since the attachment of the bone to the optic-nerve entrance would be more likely to set up a disturbance in the nerve itself, which might be transmitted along the nerve through the chiasma, and to the nerve of the healthy eye. But here we have, as the prominent symptom at least, the irido-choroiditis as we usually find it in sympathetic ophthalmia. That the cause is microbic must be seriously questioned, unless we are prepared to admit the very prolonged vitality in germs remaining in a quiescent state.

FORMATION OF BONE in the eye is most commonly found in connection with inflammation in the choroid, and often as a shell occupying the position of that membrane. We find occasional mention in literature of cases in which this connection with the choroid seems to be doubtful. I am not able to recall any recorded instance, however, in which the bony growth appeared to originate from the optic-nerve entrance, as it undoubtedly did in this case. It almost seems as if the detached and degenerated retina had undergone this bony transformation, or else that it had taken its origin from the vitreous itself. Another feature of the growth which I do not think has been described in any other case is the presence of fat cells in large numbers.[1] The connection between these and the bony tissue is obscure, unless we regard it as the effort to complete the bony transformation by supplying it with marrow.

CASE IV.

TOTAL DISLOCATION OF THE LENS UNDER THE CONJUNCTIVA TO THE NASAL SIDE FROM A BLOW; REMOVAL; PRESERVATION OF THE EYEBALL.

A man of forty-five years was admitted to the Providence Hospital on September 20, 1891, with the history that while splitting kindling-wood two days before a piece flew up and hit him on the right eye.

When I saw him there was swelling of the lids, intense bloody

[1] I have found, since this has been in type, that De Wecker figures a bony formation in the eye in his text-book, 1889, in which there are a few fat cells. He credits the observation to Haase.

chemosis of the ocular conjunctiva, with a large ill-defined swelling to the nasal side of the cornea. The cornea itself seemed clear, but the anterior chamber was filled with blood. Tension was much reduced, and there was great pain. It looked as if there had been an extensive rupture of all the coats of the eyeball, and the prognosis seemed unfavorable for preserving the globe. It was determined, however, to attempt to save it. He was placed in bed, hot antiseptic dressings were applied, and pain quieted with anodynes. In a few days improvement began to show itself, and at the end of two weeks the eyeball was comparatively clear and presented the appearance shown in the drawing, Fig. 6. The large tumor with a circular outline to the nasal side of the cornea I took to be a dislocated lens. The pupil reached up to the inner edge of the cornea on that side and was irregularly triangular in shape. The tension had increased somewhat. I resolved to remove the dislocated lens from under the conjunctiva, and on the

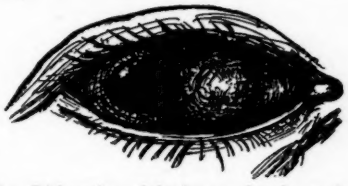


FIG. 6.—Dislocation of the lens under the conjunctiva.

5th of October I did so by making a longitudinal incision in the conjunctiva over it. A quantity of soft lens substance immediately came out. The nest which the lens had made for itself in the tissues was thoroughly cleansed by a spoon and irrigation. There was no escape of vitreous, showing that the scleral wound had perfectly healed. The eye was made thoroughly aseptic and bandaged. No reaction followed. The conjunctival wound healed nicely and when examined on the 28th of October tension was almost normal. The anterior chamber was muddy with the remains of hemorrhage. The inner side of the cornea is bulged considerably forward; no reflex from fundus; no pain.

In this connection I give a sketch of

CASE V.

A CASE OF PARTIAL DISLOCATION OF THE LENS UNDER THE CONJUNCTIVA UPWARD.

T. H. M., age forty, presented himself at my clinic on February

18, 1890, with the history of a blow on the right eye some days before. An examination showed a tumor at the upper sclero-corneal margin which proved to be the lens, a portion of which was evidently still engaged in the scleral rupture, Fig. 7. There

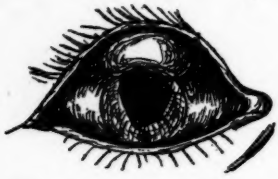


FIG. 7.—Lens engaged in a scleral rupture.

was a retroversion of the iris at the location of the wound. The pupil was black, but there was no reflex from the fundus. There was but a small amount of congestion of the conjunctiva. He promised to return and have the lens removed, but failed to come and has not been seen or heard of since.

CASE VI.

SUCCESSFUL EXTRACTION OF A FLOATING DEGENERATED LENS FROM THE VITREOUS CHAMBER.

A negro man sixty-nine years old was admitted to the Providence Hospital for mature senile cataract of the right eye on June 11, 1891. This was extracted successfully without iridectomy, and the healing was normal and the result satisfactory. There was no accident during the operation, though the vitreous was evidently fluid. The left lens, perfectly and uniformly white, was floating in the vitreous humor, and he reported that the eye had been bad for a great many years. When the lens was not behind the pupil he could see, and this was all the vision he had during the maturing of the cataract on the right eye. The tension was a little below the normal. He expressed an earnest desire to have this eye operated upon also, though warned that the result was very doubtful. On the 10th of June I extracted the floating lens in the following manner:

The assistant held the upper lid gently with his fingers against the orbital edge. I fixed the ball with the forceps just below the vertical meridian of the cornea and made puncture and counter-puncture with a Graefe knife as in ordinary extraction. As soon

as the counter-puncture was effected, and there was an escape of aqueous, I made firm but steady pressure with the fixation forceps directly backward. This threw the lens forward into the pupil and thus prevented an escape of the vitreous until the completion of the section, when the persistent backward pressure delivered it through the pupil with a gush of fluid vitreous. We were prepared for this, and as soon as the lens was thrown out the assistant quickly dropped the upper lid, and the bandage was immediately applied. The dressing was not disturbed for five days, and when the eye was opened at the end of that time the corneal wound was found well united, with an entanglement of the iris, however, as was expected. There had been no undue reaction, and there was, and is yet, quite an amount of vision. The lens, which came out in its capsule, was found to be entirely fluid, and rolled about like a drop of water. Unfortunately, while manipulating it, though very gently, the capsule burst and the contents, which seemed clear, ran out and not a trace of nucleus was visible. The capsule also was quite transparent.

In addition to the interest attaching to a successful extraction of a floating lens, the condition in which the lens was found, I think, affords a possible explanation of the sudden disappearance of some long-standing cataracts, of which we now and then have accounts. It would be very easy in a case like this, by a sudden jar or by a continuance of the regenerative process, for the capsule to have ruptured, when the contents would diffuse itself readily in the fluid vitreous. It might be advisable in such cases, for the attainment of this end, to prick the lens with a needle. I have used the bident devised by Dr. Agnew three times in extracting lenses dislocated into the anterior chamber, but I deem the method I employed in this case preferable for lenses floating in the vitreous.

Case VII.

CHEMOSIS OF THE CONJUNCTIVA AND LID CAUSED BY THE INGESTION OF A SINGLE GRAIN OF QUININE.

The vagaries of quinia intoxication are very great, and one of the most interesting in its effects on the eye that I have seen is the following:

Mrs. W. H. R., age thirty-two, came on March 6, 1891, with a marked clear chemosis of the outer part of the bulbar conjunctiva and the lower lid of the right eye. On making inquiry as to the cause she stated that an hour before she had taken one grain of sulphate of quinia. It appears that she has always been peculiarly susceptible to the influence of quinia. In early life, whenever taken in any quantity it produced urticaria. Three years ago, however, she was able to take it without any unpleasant manifestations, but one year ago her physician, Dr. Busey, prescribed four grains, and in one hour it was followed by a marked chemosis of the lids and conjunctiva of both eyes. This subsided in about two days. It was looked upon as a mere coincidence, and some months later the quinia was repeated with the same result as regards the chemosis. This morning at nine o'clock she ventured to take a single grain with the result as described. Vision was not impaired, and there were no unpleasant general manifestations. The chemosis subsided in about forty-eight hours.

Case VIII.

PERIODIC CONGESTION OF THE CONJUNCTIVA FROM VASO-MOTOR DISTURBANCE.

Mrs. J. W. B. I saw first March 3, 1884, on account of congestion of the conjunctiva which had come on suddenly the day before. There was no discharge of mucus or pus, but quite a flow of hot tears. The congestion of the conjunctiva was quite marked and mostly pericorneal, and the eye generally had a suffused look. The conjunctiva of the lids participated very little in the congestion. The iris was normal. There was some photophobia but no decided pain. She states that she has had occasional attacks like these during and since the climacteric period ; she is now over fifty. They are always preceded by some nervous disturbances, the principal of which are coldness of the extremities and drowsiness. They have been known to follow nervous excitement or strain. These attacks have been treated at different times as iritis and conjunctivitis by means of leeches, astringents, etc. The attacks generally last about three days. Sometimes one eye is affected and sometimes the other, very seldom both at once. There is always a feeling of heat, and a flushing of the side of the head corresponding to the eye affected.

They would occur sometimes as often as every two months, but once she was free for two years. She has slight hypermetropia in the right and a hypermetropic astigmatism of 0.5 in addition in the left.

There can hardly be a doubt that the congestion in this case is due to a disturbance in the vaso-motor nervous system, though an exact connection with the cause cannot be made out beyond its association with the climacteric disturbances. Of late years the attacks have become much less frequent and severe, owing most probably to the fact that her general health has been much improved by rest and travel.

Case IX.

WRINKLING OF THE CORNEA.

That the nutrition of the eye is interfered with to such an extent as to cause a contraction or wrinkling of the cornea in certain cases of general malnutrition is well known, but I do not think it is generally recognized that an inflammation, confined to one eye, will bring about such a change in the corneal outline. It is very probable, however, that if we examined eyes in a state of inflammation by means of the keratometer more frequently, such changes in its curvature would be observed oftener. The most marked example of this that I have observed is as follows:

Mrs. L. S. F., age twenty-five, was first seen March 21, 1889. There was then a good deal of suffusion of the right eye, with pain, which had existed for several days; it was somewhat sensitive to touch. She had had an inflammation in that eye some years ago. The cornea was, at the time of the examination, perfectly transparent with no sign of present or past inflammation. Vision in the right eye was $\frac{5}{10}$, in the left $\frac{5}{5}$, and in the latter was increased by — 0.5 180. No glass improved vision in the right. The ophthalmometer gave, in the left, a curvature corresponding to 40.5 D in the horizontal, and 39.25 D in the vertical meridian. In the left it gave 40 D, but the image was very irregular. Examination with Placido's disk gave the image as shown in the drawing, Fig. 8. The peculiarity of this image is that, though

the lines are approximately circular as they are in the normal cornea, they are almost regularly fluted. I have frequently seen parts of a line or lines of this form in corneal troubles, but never, as in this case, throughout its whole extent and affecting all the circles. The skiascope did not show any amount of irregular astigmatism, but the ophthalmoscopic picture was not as clear

FIG. 8.—WRINKLING OF THE CORNEA.

and distinct as in the other eye. The iris was normal, tension slightly reduced. About a week later a circumscribed keratitis developed in this eye, which ran a rather slow course, but ultimately resolved itself perfectly. An examination on December 14th showed that the cornea was of normal transparency and vision was nearly $\frac{5}{6}$, while the keratoscopic and ophthalmometric examinations gave absolutely nothing abnormal.

It seems probable that we had here to deal with a mild cyclitis which was, however, sufficient to lower the tension and diminish nutrition to such an extent as to destroy the normal elasticity of the cornea.

(*To be continued.*)

ON CONGENITAL COLOBOMA OF THE OPTIC NERVE.

By Prof. W. MANZ, Freiburg, Baden.

Translated by Dr. Ward A. Holden, New York.

(*With Figures 1–4, Plates I. II., and figure c, Plate III.*)

In his account of the development of the eye[1] von Ammon described a peculiar condition of the optic nerve in a sheep-embryo under the name "Coloboma nervi optici," and gave a drawing of it. The observers who first saw this condition with the ophthalmoscope found that the cleft was not in the nerve proper, but in its sheath.

The ophthalmoscopic picture in the uncomplicated cases, of which perhaps twenty have been reported,[2] is on the whole similar, so that the diagnosis is not difficult. There is an excavation at the papilla, with strongly reflecting walls, for the most part bounded by a pigment layer of varying breadth. This excavation may be from two to twenty times the size of the transverse section of the nerve. The depth of the depression varies in different positions, but, as a rule, is greatest below.

This may also be the case when the papilla is not much enlarged, but is near a coloboma of the choroid; then there is a partial eccentric excavation such as that described by Jaeger.[3] These small and, for the most part, sharply limited excavations in the disc have been frequently observed of late, but they are not always situated downward, and

[1] "The Development of the Human Eye," *Graefe's Archiv*, vol. ix., p. 42.
[2] See Makrocki, *Arch. f. Augenheilk.*, vol. xx., p. 29.
[3] *Ophthalmoscopic Hand Atlas*, p. 148.

therefore may not have always the same significance with reference to the development of the optic nerve.

With Caspar[1] I am of the opinion that the condition of the vessels gives us a clue to the structure of the coloboma. In this respect we may differentiate two sorts of coloboma, that in which the central vessels emerge from the middle of the excavation, and that in which they first appear at the margin. A typical coloboma of the nerve, which I saw some years ago in the left eye of a boy of fourteen, was of the first category. The four vessels emerged from the deep central portion of the white figure, and were distributed with a certain amount of symmetry to the four quadrants of the fundus, no anastomoses between them being found.

This condition, which has been seen in some other cases, differs from the majority, of which the case to be described is an example (Fig. c, Plate III.). Here almost all the vessels appear at the periphery or quite at the margin, none being seen in the middle; or they pass from some portion of the margin over the coloboma, as in this case, from below upward. This latter condition has been explained by anatomical examination; the former has not been so explained as yet, and our idea of the form and structure of the intraocular end of the optic nerve in these cases is still hypothetical. Caspar also divided the cases into groups with respect to the arrangement of the vessels, but gave a third variety in which the vessels appeared in the neighborhood of the upper margin, which resembles more nearly the condition in those cases in which the disc lies at the upper margin of a coloboma of the choroid, and the greater portion of the vessels run first in a characteristic way to the upper portion of the retina. Between this form and the second named above there is this great difference, that in one the central vessels run in the optic nerve, and in the other, outside the nerve.

From these introductory remarks I shall proceed to the description of the eyes which I have examined anatomically. For the human eye I am indebted to the kindness of

[1] "On Coloboma of the Optic Nerve," *Inaug. Dissert.*, Bonn, 1887.

Professor Pflüger of Berne, and to Dr. Eissen assistant to the Berne eye-clinic for the clinical notes accompanying it, and the ophthalmoscopic drawing which is reproduced here.

P. A., a farmer, aged twenty-five, was admitted to the medical clinic with phthisis pulmonum. The patient had had poor vision from childhood, and was sent to the eye-clinic for examination.

Both eyes were of normal size, the cornea, lens, and vitreous clear in each, the pupils responsive to light.

The ophthalmoscope showed in the position of the disc a fairly round white field (Fig. c, Plate III.) excavated in varying degree in different portions. The functional examination of the eye gave a myopia of 6 D, while with the ophthalmoscope the myopia was 10 D in the middle of the coloboma, and from 13 to 14 D near the lower margin. The coloboma is surrounded above, below, and to the inner side with a white ring, which at its inner and outer margins is pigmented; at its inner side there are irregular patches of pigment in the coloboma itself. The greater portion of the coloboma is of a glistening white color, and the lower portion is funnel-shaped and its margin sharply marked.

The retinal vessels which come from below bend abruptly at the margin of the funnel and vanish into the depth of it, as in case of a marginal excavation; and the vessels which descend from above seem also to take their course in the funnel.

In the periphery the fundus is uniformly red and shows no pathological changes.

The patient died, and the eye was enucleated twelve hours after death and put into Müller's fluid. The hardened ball had the following diameters: sagittal 27 *mm*, transverse 27 *mm*, and vertical 26 *mm*. The corneal diameters were: transverse 13 *mm*, and vertical 11.5 *mm*.

Connected with the ball was a portion of the optic nerve 15 *mm* long; with its sheath its diameter was 5 *mm* at its insertion, and 4 *mm* at its central end; without its sheath its diameter was 3.5 *mm*.

Exteriorly the ball appeared well-formed excepting a slight prominence below the entrance of the nerve. After being rehardened in alcohol the ball was divided by an

equatorial section, and the posterior half drawn, double the natural size (Fig. 1, Plate I. II.).

As the drawing shows, there is an excavation at the disc, 4.5 *mm* high and 4 *mm* broad, with a sharp margin below and at the sides.

The upper margin is formed by a thick elevated fold which spreads out fan-shaped into the retina. At either side of this elevation the floor of the excavation is red and translucent. The ball was then cut at right angles to the previous section, the knife passing through the centre of the nerve entrance, when the relation of the nerve to the coloboma could be made out with a loupe. The nerve, as seen in Fig. 2, lies only in the upper portion of the coloboma, and joins the sclera above in the normal manner, but below there is a broad space between it and the scleral margin. The foramen scleræ posticum is therefore markedly widened, measuring 5 *mm*, while the diameter of the optic nerve at the lamina cribrosa is only 2 *mm*. The lower larger portion of the foramen is filled with an areolar tissue which lies behind the plane of the inner surface of the sclera. This tissue consists for the most part of coarse and fine tracts of connective tissue, which in the middle layer cross and intermingle, leaving open spaces of varying size and form, the larger ones distinguishable macroscopically. Many of these cavities, which rarely have an endothelial lining, communicate with one another, and are separated only by thin septa. These cysts lie mostly near the inner surface of the coloboma, some, however, deeper in the angle between the optic nerve and the sclera, but all in the lower portion of the ball. A particularly large cyst (*c*) lies at some distance from the nerve, on the outer surface of the sclera, which latter, with its predominating longitudinal fibres, is of a closer texture than the areolar tissue lying on it.

This tissue runs from the nerve across beneath the sclera and into the retina, and at this point the sclera projects over the coloboma, forming the sharp margin seen with the ophthalmoscope.

The upper margin of the scleral opening, of normal form, compresses the optic nerve just within the well-developed

lamina cribrosa, and the fibres of the nerve pass for the most part upward, a few passing downward over the coloboma.

As the number of nerve fibres varies in different preparations, we must assume that the fibres passed the lower margin of the coloboma in isolated bundles. This is of importance in explaining certain functional disturbances which are found with this malformation. While the central acuity of vision is more or less reduced, in some cases, as *e. g.* in these reported by Nieden,[1] there is a sharply limited defect in the upper portion of the visual field, reaching to the point of fixation.

The microscopic examination in our case showed that there had not been a defect in the lower portion of the field, as the portions of the retina above and below the coloboma were not particularly different. In both locations the layers of the retina showed their normal arrangement, and were equally thick; the layer of rods and cones was present, as was also the layer of nerve cells above the nerve-fibre layer.

Choroid and pigment epithelium were normal, or showed merely irregularly formed clumps of pigment at the margin of the scleral opening, explaining the single or double pigment girdle of the coloboma that was seen with the ophthalmoscope.

The central vessels did not run in the nerve but beneath it, partly in its external sheath, partly between the external and internal. Here were found a number of vessels, cut obliquely and transversely, having thick walls, and in calibre somewhat exceeding the normal central artery. Some of these vessels lay in the sheath of the nerve, others outside; almost all, however, perforated the floor of the coloboma, reached its inner surface low down, and gave off branches running in the disc and over the lower margin of the coloboma. In the optic nerve itself was but a single small twig entering below and running near the neurilemma toward the lamina cribrosa.

The microscopic examination thus proved what the ophthalmoscope had made seem probable, that the central

[1] "Four Cases of Coloboma of the Nerve Sheath, without Clefts in the Uveal Tract," these ARCHIVES, viii., p. 501.

vessels did not pass to the retina from the optic nerve, but from outside it. What was found here holds good for all the cases in which the vessels appear in a similar manner behind the margin of the coloboma. H. Becker,[1] found a similar condition of the vessels in the case which he examined microscopically.

The position of the central vessels seems of importance in the genesis of this malformation. The optic furrow may close without having included the vessels, not, however, without retaining evidences of such abnormal closure. In this case the sheaths of the optic nerve were abnormal. The conditions might probably have been more clearly studied in transverse sections, but they are clearly recognized in the longitudinal. The dural sheath near its insertion is thicker (0.15 *mm*) than the normal, but it is particularly thick below and passes over into the connective tissue, which fills the angle between the optic nerve and the sclera, forming the floor of the coloboma. The inner sheath, here 0.03 *mm* thick and separated from the outer sheath by a broad intervaginal space (0.15), extends to the lamina cribrosa.

The structure of the optic nerve is normal, as is also that of the anterior segment of the ball.

The abnormal features in this eye were limited to the anomalous entrance of the optic nerve, and in fact to the nerve sheaths, which form the lateral connection between the nerve and the ball; we have then a coloboma of the sheaths of the nerve with which the nerve proper is only indirectly concerned.

An analogous condition has been found in three other eyes that have been examined anatomically. Liebreich first published an ophthalmoscopic drawing of such a case,[2] and examined two such eyeballs in Arlt's clinic. The sections explained the ophthalmoscopic picture; the sheath of the optic nerve beneath the disc before passing over into the sclera was widened out into a deep pocket, over which stretched a membrane proceeding from the nerve,

[1] "A Case of Microphthalmus Congenitus Unilateralis," *Graefe's Archiv* vol. xxxiv., p. 105.

[2] *Graefe's Archiv*, vol. v., p. 246, Liebreich, *Atlas*, Plate XII., Fig 4.

while the margin of the excavation was continuous with the sclera bounding the nerve above. As no microscopic examination was made, the nature of this membrane was not explained, but Liebreich believed that although continuous with the optic nerve and retina, it contained no retinal elements.

Falchi [1] has recently described a case of hydrophthalmus, having what he called a coloboma of the optic nerve. His case resembles mine in some respects, but there are important differences between them, so that I am not certain that his case should be considered one of coloboma of the sheath.

The second case of coloboma of the optic nerve that I examined anatomically was in a white rabbit, in which the malformation was discovered by accident. The condition existed in each eye, in the right being accompanied with a change in the vitreous which with the ophthalmoscope appeared to be a posterior polar cataract with a persistent hyaloid artery, a diagnosis which was only partially confirmed by the autopsy.

The eyeballs appeared normal exteriorly, the anterior chamber being somewhat deeper perhaps than is usual in the rabbit.

In the left eye the media were clear. In the position of the disc was a large, deep, nearly circular excavation, sharply limited from the surrounding parts. The network of vessels which borders the lower margin of the disc in the rabbit, was here below the lower margin of the coloboma, in which were but a few small vessels.

In the right eye the changes in the disc were similar, but being veiled by the opacity of the vitreous were not so clearly seen.

In the enucleated balls there was a conical prominence of 5 *mm* near the posterior pole, and a thinning and stretching of the sclera beneath the disc. When the right eye was opened behind the equator, a white cord containing a vessel filled with blood was seen running from the nerve to the

[1] "On Acquired Hydrophthalmus," *Beitr. z. path. Anat. und allg. Path.*, Ziegler, vol. vii., p. 411.

lens, being continuous below with a delicate membrane which passed through the vitreous to the retina (Fig. 3, Plate I. II.). A number of sections showed this cord ending free in the vitreous as in the figure; some preparations, however, showed its continuation and end, the latter being of two varieties: either the cord bent sharply and spread out into a lamella showing retinal structure, or the transition occurred at the point of bending without the lamellar spreading. This remarkable portion is shown highly magnified in Fig. 4, Plate I. II. The cord-like structure is seen to broaden gradually at the turn and finally to become transformed into the various layers of the retina.

Coloboma of the nerve and nerve-sheath has a further interest because of its relation to another anomaly which has but recently received much attention, viz., conus inferior. Since it was found to be congenital, it has been proved to be due to a defective closure of the fœtal ocular cleft. I would refer the reader particularly to the publications of Schnabel,[1] Vossius,[2] Van Duyse,[3] and Fuchs,[4] who have supported this view, and have found disturbances of vision and limitations of the visual field with conus inferior, showing that the distribution of the nerve fibres in the retina is not normal.

The fact that these coni are found in the region of the nerve entrance and are therefore not to be considered small choroidal colobomata, is shown by the frequent anomalies in the ramification of the central vessels, and the different ces in the level of the disc.

Whether congenital coni of this sort are also found at the temporal side of the nerve, as many claim, and whether these different positions are due to a turning on its axis of the fœtal eyeball (Vossius), are questions which cannot yet be answered, and for the solution of which more extended embryological and histological studies must be made, particularly as regards the macula lutea.

[1] "On macular Coloboma," etc., *Wiener med. Blätter*, 1884, No. 6–9.
[2] "Contributions to the Study of Congen. Conus," *Zehender's klin. Monatsbl.*, vol. xxiii., p. 137.
[3] "Contributions to the Study of the Anomalies of the Optic Nerve," *Ann. d'Oculist.*, vol. xcii., p. 44.
[4] "A Contribution to the Congenital Anomalies of the Optic Nerve," *Graefe's Archiv*, vol. xxviii., p. 139.

Explanation of the Figures.

PLATE I. II.

Fig. 1. Front view of the disc in the human eye.

Fig. 2. Vertical section through the coloboma in the same eye: *r* retina; *ch* choroid; *scl* sclera; *c c c* cysts; *v v v* vessels.

Fig. 3. Vertical section of the nerve entrance in the rabbit's eye: *r* retina (pigment epithelium, red); *ch* choroid; *o* optic nerve; *l* lens.

Fig. 4. The same eye. The vitreous cord passing over with the retina: *f* cord in vitreous; *r* fragment of retina; *c* cysts in the retina.

PLATE III., FIG. C.

Ophthalmoscopic picture (erect image) in the human eye.

DETACHMENT OF THE CHOROID.

By Dr. ANTON ELSCHNIG,

ASSISTANT TO PROFESSOR SCHNABEL, GRATZ.

Translated and abridged by Dr. J. A. SPALDING, Portland, Me.

(*With one figure—Fig.* 5, *Plate I. II.*)

IT is a very remarkable fact that clinical morbid pictures which were observed and carefully studied, and zealously followed up in the early days after the discovery of the ophthalmoscope, do not seem ever to have been seen again, and that at a time when the practical side of ophthalmoscopy has never before been so scientifically and ardently pursued. Thus, for example, as far back as 1854, Jaeger accurately described an ophthalmoscopic image of stasis of the vascular system of the retina.[1] But although a few observers have seen an image bearing some slight resemblance to that of Jaeger, yet in the totality of all the symptoms not a single ophthalmoscopist has since that early date described an image that could be reasonably regarded as precisely similar to that which this learned surgeon has given to the world in his reports.

v. Graefe and Liebreich in 1856 or 1857 described detachment of the choroid as a morbid condition in which without the slightest alteration in the external form and nature of the eye, and with preservation of perfectly normal tension of the globe, a firm, smooth, precisely circumscribed globular nodule resting on the sclera, and with a rather nar-

[1] "Ueber Staar und Staaroperationen," p. 104, and "Ergepnisse der Untersuchungen mit dem Augenspiegel," 1876, p. 100.

row base, and covered with choroid and retina, is developed within the eye. It may rise 6 *mm* above the level of the sclera, grow with great slowness, is next followed with detachment of the retina and terminates in softening and phthisis of the globe long since rendered blind by the disease.[1]

Since then but few cases have been reported, among which are first that by Knapp (Intraoculare Geschwuelste, 1868, pp. 194–200), who extracted with partial loss of vitreous a dislocated lens in its capsule from the eye of a man of forty-six. Five weeks later, after the incision had spontaneously opened in the third week after the operation, and perception of light had entirely disappeared, there came to view in the vitreous, and close behind the plane of the pupil, three brown globular masses with a velvety surface, which, resting in the ciliary region, touched one another, and totally hid the upper and inner portion of the vitreous.

As the case seemed to be one of choroidal sarcoma, the eyeball was enucleated, when the tumors were found to represent detachment of the ciliary body and of the anterior portion of the choroid from the sclera, due to the presence of a transparent fluid.

De Wecker, Michel, Berger, Hjort, Hay, Walter, and Groenouw have described similar cases ophthalmoscopically, but none of them corresponded precisely in all their features with the image given us so long ago by v. Graefe and Liebreich.

The following case was observed at three different periods, with long intervals between, during the space of eight years, and for the first time just after the beginning of the visual disturbances, when the alterations were already considerable, but before the detachment had made its appearance, while at the second and third periods the nodule covered with the choroid and retina had already attained considerable size, and exhibited in the most beautiful manner all of the characteristics described so minutely by the first observers.

[1] *v. Graefe's Archiv*, Bd. iv., Abt. 2, p. 225, and Bd. v., p. 259, and in *Liebreich's Atlas*, Text, p. 18, and Plate VII., Fig. 6.

Michael K., aged forty-five, was first seen March 1, 1882. Left eye externally normal, media transparent, optic papilla rather more pallid than usual, but with normal contours, retinal vessels normal. The region of the macula is covered with scattered, irregular, yellowish, glittering spots. Outward from the papilla, and about half a papilla diameter distant, is an irregularly shaped whitish-green patch of about two papilla diameters, in which the retinal vessels are at one spot indistinct, then hidden entirely from view, and then again starting up into plain view. The entire patch, which bears the appearance of swollen retina, is marked by various differences in level.

The right eye is entirely normal.

Diagnosis : Retinitis of the left eye.

Nearly seven years later, January 4, 1889, the patient returned for a second examination. Since his first visit the sight of the left eye has slowly and steadily diminished, though there has never been any sensations of pain in the eye.

The central portion of the visual field is absent over a circle of from 30° to 40° in diameter, but in the remaining ring-shaped zone, not only are fingers counted at a short distance, but in the superior and middle portions of the field large red and blue squares of paper are distinctly recognized.

After remaining a short time in the hospital the patient disappeared from view till January 2, 1890, when at our request he once more presented himself. He reported that the sight had been totally lost soon after his last visit, but that otherwise there had been no change in the eye.

The ophthalmoscopic image, as seen on January 4th, is depicted in Fig. 5. The posterior portion of the vitreous exhibits a structure completely solid and immovable, slightly transparent, rather oval in shape, and projecting forward into the vitreous to a considerable extent, just below and to the temporal side of the papilla. It is about six papilla diameters across, and four in vertical measurement. As calculated by the aid of the refraction ophthalmoscope, it projects nearly 6 *mm* into the vitreous above the level of the retina. It is covered scantily with vessels and pigment. The margin is overhanging, so that the base of the nodule cannot be seen with the ophthalmoscope. The retina is detached at a little distance from the margin, and exhibits the usual image of that condition. At other portions of the fundus the retina lies in place. The vitreous, close around the margin of the prominence, is filled with fine opacities.

The tension of the right eye is normal, that of the left subnormal.

The only observable alteration during a month's sojourn in the hospital was a slight increase in the retinal detachment.

The only change between the first and the second visit was to be seen in the increased elevation of the growth, and the serous infiltration in the retina.

January 5, 1891, the patient came once more, the eye now being distinctly smaller than the other, and the retina exhibiting hemispherical detachment in three places in the fundus.

If now we think over the history of this case we notice that at the spot where, in 1889 and 1890, v. Graefe's and Liebreich's ophthalmoscopic image was well defined, a distinct inflammatory condition of the retina (retino-choroiditis) had been observed seven years before. Hence the case before us belongs really to the broader group of retino-choroiditis, and we feel justified in including the cases reported by v. Graefe and Liebreich, as well as that of Berger, under this title.

In v. Graefe's second case the detachment occurred suddenly, and produced almost instantaneous blindness. v. Graefe that there could be little doubt of the accuracy of what the patient asserted, because he was an officer accustomed to gunning, and in the habit of frequently using first one eye and then the other. For that reason, then, he thought that the trouble was of an apoplectic nature.

Pathogenesis of the Detachment of the Choroid.

A circumscribed retino-choroiditis with a moderate amount of exudation occurs in the choroid and between the latter and the sclera, so that the choroid is raised in a flat surface from over the sclera. The choroid with the retina in the immediate vicinity of the inflammatory focus becomes intimately agglutinated with the sclera by the action of the products of the chronic inflammation. At the same time, the inflamed portion becomes encapsulated. Ultimately, if the inflammation and the exudation persist, both of the inner membranes of the eye must necessarily be pushed forward into the vitreous in the form of a nodular swelling.

The intimate union of the choroid with the sclera in the neighborhood of the focus of exudation alone causes the nodular form of the detachment, and prevents it from extending over a greater extent of surface of the fundus of the eye.

When finally the disease has reached the same intensity, as in the case so often cited from v. Graefe and Liebreich, and indeed in our own case, the circulatory and nutritive disturbances which it excites in the rest of the eye produce a deleterious detachment of the retina, while the diminution in the size of the eye closes the scene.

A CASE OF SARCOMA OF THE CORNEA.

By Dr. KONRAD RUMSCHEWITSCH, Kiew.

Translated by Dr. Ward A. Holden.

(*With Figure 6, Plate I. II.*)

In 1870 Classen (*Arch. f. path. Anat.*, vol. l., p. 56) distinguished two principal forms of corneal neoplasm, melanotic sarcoma, and epithelioma, which always develop in the region of the limbus conjunctivæ. Later investigators have confirmed his views. Benign tumors of the cornea are of extreme rarity. The case which I shall describe is of particular interest as the malignant growth developed in the cornea proper.

A peasant, aged sixty-one, received a blow on the head a year and a half ago, which was followed by hemorrhage from the right eye and ear, and loss of consciousness; the sight of the right eye failed somewhat. A year ago he was again struck on the right side of the head and there was again hemorrhage from the right eye; vision was entirely lost and the eyeball began to protrude through the palpebral fissure so that the lids could not be closed.

A soft, smooth tumor protrudes through the palpebral fissure. The ball preserves its mobility and its perception of light. The eyelids are normal, the conjunctiva is pale, the limbus slightly hyperæmic and thickened. A sound can be passed at some points between the tumor and the margin of the cornea.

The eye was enucleated. The further history of the patient was not obtained.

The enucleated ball was hardened in Müller's fluid and later in alcohol. Fig. 6 shows a horizontal section of the anterior segment of the ball. The tumor has a fairly uniform thickness, becoming a little thinner toward the margins. In the sections radiating stripes may be seen with the naked eye.

The upper half of the ball was imbedded in celloidin and the lower in paraffin.

HISTOLOGICAL EXAMINATION OF THE TUMOR.

A. *Conjunctiva.*—The conjunctiva was thickened particularly in the upper outer segment. The epithelium consisted of ten or more layers. The cells of the lowest layer were of cubical form, in the following layers round or irregular, and in the outer layers flat. For a distance of 2 *mm* from the limbus, epithelial processes dipped down into the cornea, and at the corneal margin were well-marked papillæ. These papillæ consisted of loose connective tissue containing numerous round cells, particularly about the vascular network that was always present. Deeper there was a thick layer of still looser connective tissue with vessels and many cells. This layer became gradually thinner as it approached the corneal margin and was bounded from the latter by the epithelial processes which dipped down in the region of the limbus. The blood-vessels of the conjunctiva were much thickened, so that the conjunctiva resembled cavernous tissue. The vessel walls were of considerable thickness and were surrounded with few leucocytes, whereas the thin-walled vessels in the papillæ were surrounded with quantities of lymphoid cells.

The tumor approached nearer the corneal margin in the upper outer segment and more conjunctival vessels passed to it here than at any other point. The rôle of the conjunctiva in the development of the tumor was in furnishing the blood-vessels.

B. *The Epithelium of the Tumor and its Connection with the Cornea.*—The epithelium of the cornea passed uninterruptedly over upon the tumor, being thickest at its base. The blood-vessels ran beneath the epithelial layer, but after reaching the tumor they divided and the branches assumed a radiating direction. In the vascular portion of the conjunctiva there was little fibrillar connective tissue and few lymphoid cells. In the base of the tumor there was more loose connective tissue.

The inner margin of the epithelial demarcating layer, or rather the margin of the opening through which the tumor was connected with the cornea, was much thickened and in places uneven. Excepting in the upper outer segment of the cornea in which the nutrient vessels of the tumor entered, I found no changes either in Descemet's membrane or in the deep lamellæ, but in the superficial portion the lamellæ were loosely connected and there were many corneal corpuscles but no trace of leucocytic infiltration. Bowman's membrane was also fully preserved up to the margin of the opening, where it became interrupted and the portions which were preserved had an abnormal direction.

C. *The Constitution of the Tumor Proper.*—Horizontal sections stained with hematoxylin slightly magnified show the darkly stained demarcating epithelial layer with the opening about 3 *mm* in diameter. Just outside this, in the base of the tumor, was a layer of light violet color with prolongations 1½ *mm* in diameter, running out to the periphery of the tumor. In the temporal half of this layer were vessels from the conjunctiva, between which the connective tissue was better developed than in the vascular portion of the conjunctiva and cornea. In the nasal half of this layer fibres of the substantia propria of the cornea crossed each other in all directions, and few cells were present. External to this layer were the clear stripes which ran out in a radiating direction through the entire tumor. The remainder of the mass, stained darkly with hematoxylin, made up the tumor proper.

In the base of the tumor vessels and fibres of the substantia propria of the cornea crossed each other at all

angles. The bundles of fibres passed over into ordinary loose connective tissue in the tumor. Very little connective tissue entered the tumor with the vessels. The connective tissue with the vessels formed the stroma of the tumor which divide it up into fields of various sizes. In the mass of the tumor the vessels were mostly very small, and capillary vessels were found in considerable quantity just beneath the epithelial covering of the tumor.

At some points on the surface of the tumor degenerated blood was found in place of epithelium, and fresh hemorrhages were seen in the substance of the tumor proper. There was very little intercellular substance. The cells were of various forms. Near the clear stripes the sarcoma cells were small and spindle-formed with the long axis perpendicular to the surface of the cornea, and these made up the bulk of the tumor. Some round cells, apparently leucocytes, were found near the blood-vessels. In the base of the tumor were large vessels which broke up into many branches, which latter ran in a radiating direction to the periphery of the tumor.

The narrow tracts of connective tissue after reaching the tumor divided in such manner as to give a picture similar to that of the radiating fibres of the retina at the limitans interna. This same direction was followed by the capillary network and also by the spindle-formed sarcoma cells.

The capillary vessels stand in immediate relation to the structure of the tumor. Next the capillary walls were one or two rows of round cells similar in every way to leucocytes, and farther outward were spindle cells with the long axis parallel to the long diameter of the meshes of the capillary network. Between the round and spindle cells transition forms were noticed.

Only the large cells formed the groups usually found. In the bulk of the tumor the lymphoid and the small spindle cells were mingled, although the lymphoid cells were grouped about the vessels. It seems to me, therefore, that the elements of the tumor developed from lymphoid cells which escaped from the vessels.

Explanation of the Figure (slightly magnified).

Conj, conjunctiva bulbi.
Scl, sclera.
Am, muscle of accommodation.
Pr, perichoroidal space.
I, iris.
C, cornea.
mB, Bowman's membrane.
mD, Descemet's membrane.
L, lens.
S, new growth.
es, epithelial covering.
ww, proliferated epithelium.
ex, hemorrhages.
el, proliferation of epithelium of limbus.
G, vessels.
ec, corneal epithelium.
cew, proliferation of corneal epithelium.

ON PIGMENT STRIÆ WITH SECONDARY CHANGES IN THE RETINA AFTER HEMORRHAGE.

(FROM THE EYE CLINIC OF DR. NIEDEN, BOCHUM.)

BY DR. O. PLANGE, MÜNSTER.

Translated by Dr. WARD A. HOLDEN, New York.

(*With Figs. a and b, Plate III.*)

WHILE assistant in Nieden's clinic, I observed a peculiar affection of the retina which in appearance bore a certain similarity to the disease known as retinitis striata, but in etiology resembled retinitis proliferans. There is no similar case, to my knowledge, in literature.

Mrs. H., aged thirty-eight, came to the clinic in May, 1889. She is of healthy parentage, and was never seriously ill until after her marriage. Since 1870 she has had severe headaches recurring periodically. These were most severe in the summer of 1879, and at that time she noticed a failure of vision, for which she consulted Dr. Nieden, and was under his treatment for a time. There was a transient improvement, but in the course of years the vision failed again. Three years ago she had pneumonia, but is now in fair health, except for the headaches, which still recur at times, but are less severe than formerly.

Following are notes from the record book, at the time of her first visit:

July 14, 1879.—The patient complained of periodic headaches since March, 1879, and a marked diminution of vision in the

right eye. Objects appeared veiled and misty at first, and this increased until objects were not seen at all directly. The trouble came on in the late months of her third pregnancy, and both the headache and visual disturbance increased after her normal delivery.

L V = $\frac{2}{3}$; R V = $\frac{1}{3}$ eccentric. Right, a small central scotoma. The ophthalmoscope shows peculiar brown membranous filaments in each eye. These have about the breadth of the retinal vessels, and are 2–3 disc diameters long. In general they run in the direction of the vessels, and at the peripheral end of each is a small retinal hemorrhage. In the right eye there are three such striæ uniting at the nasal side of the disc, one running upward, one outward, and the third downward. Besides these a similar filament runs from the opposite side of the disc to the macula, ending in a white atrophic plaque which includes the entire macula, and in which are scattered masses of pigment. In the left eye there is a single pigment stria running from the nasal side of the disc upward and inward, and ending also in a retinal hemorrhage.

No etiological factors could be discovered. The urine contains neither albumen nor sugar. There is no evidence of syphilis. The treatment consisted of hydr. biniodid. rubr. and potas. iodid. in pill form.

The case was kept under observation until November 11th, and in this time the hemorrhages partially absorbed and recurred several times in the right eye, the membranes developing as the hemorrhages underwent resorption. November 11th, R V = $\frac{1}{3}$; L V = $\frac{2}{3}$.

The condition of the fundus when I saw the patient is shown in the drawings. In the right eye peculiar dull brown striæ pass from the disc in a radiating direction toward the periphery of the fundus. Their origin near the disc is not sharply marked; they seem to proceed from a layer of opaque grayish-white glistening tissue. At this point they are double or triple the width of the central vessels, and toward the periphery they become narrower and break up into a number of plaques and points of the same color.

These striæ are included in broader light stripes, which

unite, forming a zone about the disc. The color of the lighter stripes is light gray or grayish-brown, and they give a reflex similar to that from the retina of a myopic child's eye. This reflex is seen over the pigment striæ and over the vessels which are particularly veiled in the neighborhood of the disc.

In the macular region there is a pure white plaque not giving a reflex, and stippled over with pigment masses, showing the usual picture of atrophic choroiditis. None of these plaques or stripes project into the vitreous.

There are four main branches of the pigment striæ, each of which divides, and the smaller branches finally end in a number of pigment spots, as is seen in the drawing made in the inverted image. V = fingers at 3 *m* eccentrically. There is a central scotoma of 30° lateral extent and 40° vertical. The periphery of the field is free. The limits of the color fields are slightly narrowed.

The left eye shows like changes but of less marked degree. Four main pigment striæ, narrower and more tortuous than those in the right eye, run with their branches from the neighborhood of the disc out into the periphery. The light stripes following the course of the vessels in the right eye are not found here, although about the disc the red of the fundus is pale, and there is an increased retinal reflex. The fundus is otherwise normal, as are also the vitreous and lens and the remainder of the eye.

With the less marked changes in the left eye the functional examination shows it to be normal in vision, fields, etc.

The only abnormal feature elicited by the general examination of the patient was the radial pulse curve, which is particularly low and has the character of a pulsus durus with a long extended wave flattened at the summit, and scarcely an indication of the second rise, all signs of elasticity being wanting.

The history of this case shows it to be a rare and unusual form of retinal disease. The pathological process was the same in the two eyes, more extensive in the right. Without a microscopic examination it is not possible to define

it pathologically, but a detailed study of the case will allow some probable conclusions as to the nature and the more accurate localization of the disease.

The pigment striæ, the atrophic plaque in the macular region of the right eye, and the grayish-white reflecting parts, should be differentiated, since in all probability they lie at different levels, in different layers of the fundus.

In the macular atrophic plaque the white sclera shines through. No trace is seen of the choroid, which must be destroyed in all its layers. In the mass of irregular pigment clumps we see doubtless remains of the pigment epithelium, and the absolute scotoma indicates the absence of at least the nervous elements of the retina. At this point, where recurrent hemorrhages occurred, we have these deposits of pigment, and complete degeneration of choroid and retina.

The degeneration was less extensive in those parts in which the hemorrhage recurred not at the same point, but at neighboring ones. Here, after each hemorrhage, only a deposition of pigment remained, and through the coalescence of these deposits the brown stripes were formed. This process was followed by Dr. Nieden with the ophthalmoscope, and the gradual lengthening of the stripes noted in his case-book. It was noticed, also, that the patient's headache had a certain relation to the retinal hemorrhages, preceding each one with such regularity that from the recurrence of the headache a new hemorrhage could be prognosticated.

The next question is, in what tissue do these formations lie? This is more easily answered by considering the left eye, for here the details are sharper, and there is not the complication of the reflecting stripes.

The normal red is slightly pale only about the disc, the striæ pass above the choroid just as the retinal vessels do, and the pigment epithelium is everywhere normal. The pigment striæ are without doubt products of the coloring matter of the exuded blood, and lie in the retina proper. They cannot have had their origin in the pigment epithelium, as this shows no changes, and the rods and cones were

proven to be unaffected by the functional examination. The vessels lie above the striæ, and the latter must therefore lie in the middle layers of the retina.

It is impossible to say why in this case the coloring matter of the blood was not absorbed, as is usually the case, and why the hemorrhages recurred periodically. We can only suppose that in the patient's pregnancy a nephritis or a general alteration of the entire vascular system developed, which could not be determined later. This is indicated by the pulse curve, which shows that the vessel-wall had lost its elasticity, and must have undergone a pathological change. What was true of the radial artery might also be assumed to be true of the arteries of the head, and particularly of the eye, and this vascular affection may reasonably account for both the headache and the hemorrhages.

As for the grayish-white glistening stripes in the right eye, it is probable that they also were consecutive to and dependent on the original affection, although the direct connection was not clinically observed. In the case-book for 1879–80 there is no notice of their existence, and Dr. Nieden remembers that at the time the right eye presented a picture similar to that now seen in the left. The changes must have come on later, and it is probable that they developed slowly.

We have seen that these glistening stripes covered both the pigment striæ and the retinal vessels, so that the only question as to their location is whether they lie in the retina or before it in the vitreous. Where the vessels cross the pigment striæ, the reflex before the striæ is much more marked than that before the vessels which lie higher. This can only be explained by a greater thickness of the stripe, and it must therefore lie in the retina. The inner layers of the retina are then certainly involved, but possibly not merely the inner layers. The fact that the grayish color and also the reflex are more marked near the striæ and the vessels, makes it appear probable that the deeper layers of the retina are also involved. There is also a possibility that the hyaloid membrane, which lies on the limitans interna, may

also have been involved in the process, although the changes are seen to be at the level of the retina, and do not project into the vitreous.

The last question is as to the pathological character of these grayish changes. The simplest and most reasonable explanation is that there have been changes, possibly hyperplasia, in the supporting fibres of Müller, which changes are not rare after parenchymatous affections.

The supporting fibres run transversely through the retina, ending at the inner portion of the nerve-fibre layer in funnel-shaped dilatations, which unite to form the membrana limitans interna. If through some change these fibres had lost their normal transparency, they would reflect the light which enters the eye. This reflection would be greatest where the network of supporting fibres is thickest, and in accordance with the structure of the individual fibres this is at their internal end. The number of the fibres is greatest near the disc. These facts correspond to the appearance of the changes; and the peculiar glitter obtained when the ophthalmoscope was moved is explained by the fact that the individual fibres are met by the rays of light at various angles, so that moving the source of light causes other portions to be illuminated, and further by the fact that the membrana limitans interna and the membrana hyaloidea, on account of the changes in the fibres, do not present a plane surface.

I believe that so much may be said in regard to the origin, nature, and localization of the affection without verging too much upon the hypothetical. We have, then, *a deposition of pigment in striæ in the retina after hemorrhage, followed by changes—probably hyperplastic—in the supporting fibres of Müller.*

I have not found an analogous case in literature. Some cases of retinal disease, denominated retinitis striata, have been observed, but these differ in many respects from our case, and have a different origin. There is a certain similarity to retinitis proliferans, since both arise from hemorrhages, in both there is deposition of pigment, and the connective-tissue changes in these cases are not dissim-

ilar to the grayish-white stripes in ours. Yet the peculiar course of the pigment striæ, similar in the two eyes, and the fact of their not projecting into the vitreous, seem to justify us in considering the changes as constituting a retinal affection which is unique.

ON THE FORMATION OF DARK ANGIOID STREAKS AS AN UNUSUAL METAMORPHOSIS OF RETINAL HEMORRHAGE.

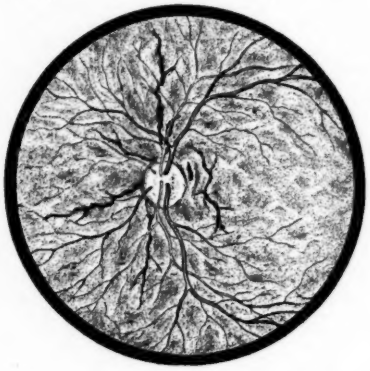
By H. KNAPP.

(With an ophthalmoscopic drawing.)

DR. O. PLANGE'S remarkable case from Dr. Nieden's practice, published in this number of these ARCHIVES, has given me the explanation of a case which was under my care two years ago. The ophthalmoscopic picture which I here reproduce from my sketch-book of opthalmoscopic drawings, is so similar to the condition in Nieden-Plange's case as to leave no doubt in my mind that both belong to the same affection, namely the conversion of extravasated blood into streaks of dark brown or black pigment in the retina. The case is as follows:

Miss Ottilie Kaiser, children's nurse of New York City, consulted me first Oct. 8, 1889, with the following history. She was well until July 23, 1889, when she went to Newport, R. I., with the family in which she was employed. Two days later she and the whole family were taken sick—from bad water as was alleged—with vomiting, diarrhœa, and general indisposition. Five days after the beginning of the vomiting she was sewing on the machine while the sun shone brightly on the plate. This produced in her eyes a sudden pain and dizziness which she could not wipe away, and her eyes have been weak ever since. The family stayed at Newport one week only. She accompanied them to Bar Harbor, Me., where her vomiting ceased in a few days, but her sight became steadily weaker. When she came to me, I found the sight

in each eye $\frac{20}{800}$, with $-\frac{1}{18}$ $\frac{20}{70}$. She read Schweigger 0.5. Her visual field was much contracted, namely: L: 45° temporally, 30° nasally, 10° up, 15° down. R: 25° temporally, 15° nasally, 15° up, 10° down. She saw better at night than in the bright day. Her pupils were responsive, both optic discs white, but the vessels of normal calibre. The background of each eye was dull and mottled. My diagnosis was atrophy of the optic nerves in myopic eyes. From the contraction of the visual field I inferred that the amblyopia would progress. I ordered her calomel tablets in $\frac{1}{2}$ cgrm. doses four times daily. She remained under treatment sixteen months, at the end of which her sight was reduced to the perception of movements of the hand. In a month from her first visit a peculiar ophthalmoscopic picture had developed. (See accompanying drawing). The odd. remained white, and the blood-



vessels nearly of normal size; the background, however, in a radius of about 6 P-Ds, still showed the irregularly mottled appearance, but the choroidal pigment was arranged in irregular figures, many small black dots, further patches with offsets, and communicating curved and angular lines, on a whitish background. Most peculiar was a system of dark-brown or black streaks, radiating from the neighborhood of the optic disc in every direction. The thickness of the streaks was irregular and varied considerably. They all lay upon the choroid, and the retinal vessels passed over them, but nowhere could I discover a direct connection between the streaks and the retinal vessels. I noticed no hemorrhages, but in a few places the dark streaks had red portions. Trying to explain

to myself the origin and nature of these peculiar streaks, which had the appearance of an obliterated system of blood-vessels, I examined the background carefully in the indirect and direct methods. The streaks originated and ended sharply in the retina without uniting with any other formation.

The further history can be briefly told. The sight continued to decrease and the field of vision to contract. The ophthalmoscopic picture, when once in the state as above described, did not materially change; the red parts on the streaks disappeared completely. The patient, who had taken mercury, iodide of potassium, salicylate of soda, iron, strychnia, cod-liver oil, and at times bromide of potassium, left off treatment on my advice.

On my request she came to be examined again, March 29, 1892. The eyes were materially in the same condition. There has been no irritation of any kind. She could count fingers near by, though not always correctly. The visual field had a radius of about 25°. The atrophy of the optic discs was marked; the retinal vessels were fairly normal. The streaks were essentially unchanged, only some were shrunken, and surrounded by white bands broader than the black centre. The mottled appearance of the background was less pronounced.

As to the etiology, our case furnishes another of these rather rare examples in which blindness follows excessive or prolonged vomiting. I have seen a few cases of this kind. They came under my observation weeks or months after the blindness had set in. All showed atrophy of the optic nerves, but I remember no retinal changes. That in the case above related there was hemorrhage into the sheath of the optic nerve is very doubtful. In the cases of hemorrhage into the sheath of the optic nerve which have come under my notice the extravasated blood could be directly seen with the ophthalmoscope to encircle the optic disc, encroaching slightly on its area and surrounding it either on all sides, or extending in large streaks 3 or 4 P-Ds over the retina.[1]

In the case under consideration the extravasated blood was evidently situated in the outer layers of the retina, for

[1] Compare my paper "On Pathological Formation of Pigment in the Optic Disc and Retina," with three colored drawings, *Graefe's Arch.*, xiv., 1, p. 252, 1868.

the retinal vessels passed over the streaks. It disintegrated the choroid, and was changed into black pigment, deposited in numerous dots and short lines, and the very conspicuous long and tortuous streaks. In Plange-Nieden's case there were signs of inflammation in the right eye only, but the optic discs did not look atrophic. The vision also was relatively good, namely: R=$\frac{1}{2}$; L=$\frac{3}{4}$.

While having the patient under observation I had no idea of the hemorrhagic origin of the peculiar dark-brown streaks, and if Dr. Nieden had not watched directly the gradual conversion of the blood into these streaks, I do not think that he or any one would have made the diagnosis on examining the conditions represented in his drawings. The left eye (Fig. 2, Plate XXIII.), with no other abnormity than a system of streaks resembling the retinal blood-vessels in every respect except their color, might have puzzled every one. In my case I looked upon those streaks as obliterated blood-vessels, either retinal or choroidal, but the explanation remained unsatisfactory. As soon as I saw the drawings of Nieden-Plange I was convinced that theirs was a parallel case to mine. To see extravasated blood converted into dark vessel-like streaks is certainly rare, yet since my attention has been drawn to this subject, I have come across forms which, though not identical, were at least similar to those under consideration. In one case, numerous small dark-red patches of blood were seen above the region of the yellow spot, and near by there were curved, dark streaks, only not so long, nor so regularly radiating as in the above cases. Below the yellow spot there was a large patch, shining white in color, and irregular in outline, over which some retinal blood-vessels passed, just as over the black streaks. Both the streaks and the white patch were evidently metamorphoses of extravasated blood and lay in the outer layers of the retina.

In this communication it has not been my intention to discuss in detail the changes extravasated blood may undergo in the retina, but to furnish a second case of the rare and puzzling formation of dark, angioid streaks which Dr. Plange has described.

ON GLAUCOMA AFTER DISCISSION OF SECONDARY CATARACT AND ITS SUCCESSFUL TREATMENT BY IRIDECTOMY.

By H. KNAPP.

IN my reports on cataract extraction, I have mentioned several times the outbreak of glaucoma after the secondary division of the capsule. Glaucoma, following sooner or later simple or combined extraction prior to any after-operation, has been described by different authors. No such case, to my recollection, has occurred in my own practice. The occurrence of glaucoma after operations for secondary cataract seems to have been but rarely recorded in literature.[1] As the number of such cases has gradually increased in my own practice, I thought it opportune to make them the subject of a special communication, so much the more as all the patients were promptly cured by an iridectomy, a fact worth knowing.

I shall first give BRIEF HISTORIES OF THE CASES, and then see what conclusions may be drawn from them.

CASE 1 (reported in these ARCHIVES, 1888, p. 71).—The case being typical I will copy the publication. Mr. Stewart, aged fifty-nine; suffering from Bright's disease and alcoholism in a high degree. Extraction April 16, 1887. Normal. Round, perfectly free pupil. S $\frac{8}{18}$. Nine weeks later a simple division of a wrinkled, not thickened or adherent capsule was, within twenty-four hours, followed by an attack of acute glaucoma. +T2. Relief by eserine for a day, but then + T2 again, and vision re-

[1] See a case by Dr. T. R. Pooley, in the *Am. Journ. of Ophth.*, 1891, No. 12.

duced to $\frac{1}{\infty}$. Upward iridectomy, the incision behind the corneal scar, gave instantaneous relief. Prompt recovery. S $\frac{20}{20}$.

Case 2 (reported as No. 67 in the second series of one hundred simple extractions; these Archives, 1889, p. 6).—M. Cramer, sixty years, of Kalamazoo, Mich. Extraction Oct. 3, 1888. No disturbance. With + $\frac{1}{8}$ S = $\frac{20}{200}$. Discission Oct. 24, 1888. No accident. Left Oct. 30th, with S $\frac{20}{30}$. Caught violent cold, with sneezing and abundant secretion. Eye painful and weak. Recovered, but eye had repeated attacks of irritation, the worst at end of Dec., 1890. An oculist gave him drops to relieve the tension. Patient came to New York Feb. 12, 1891. Eye free from inflammation. External aspect: iris, pupil, and media normal. + T1. *Glaucomatous excavation and atrophy of optic disc.* S = O.

In the third series of one hundred simple extractions, there were two cases had glaucoma after the discission, viz.:

Case 3.—Jas. Conkling (No. 24, p. 291, Archives of Ophthalmology, 1890). Fifty-nine years. Extraction April 12, 1889. Regular. S $\frac{20}{100}$. Discission in four weeks. Discharged in five days. A glaucomatous attack on the eighth day *cured* by *eserine.* S $\frac{20}{40}$; later $\frac{20}{30}$. Has remained permanent.

Case 4.—Mrs. Smith, seventy-eight years (reported as No. 49 *l. c.*). Extraction June 5, 1889. Discharged in two weeks. S $\frac{20}{200}$. Discission five weeks after extraction. Discharged in four days. Round, regular pupil. S = $\frac{20}{30}$. From sixth month on attacks of glaucoma set in repeatedly, and were relieved by eserine, until in March, 1890, the anterior chamber being shallow, the iris bulging, + T1, a regular upward iridectomy was made, which resulted in prompt and permanent recovery.

Since January 24, 1890, where the report of the third series of 100 simple extractions ends, I have made about 350 extractions, on which I shall report later. The method of operating has, as a rule, been the simple extraction, opening the capsule at the upper periphery, underneath the iris, and performing a subsequent discission of the capsule in almost every case. Particular attention has been paid to the occurrence of glaucoma, and the following cases have come under observation:

CASE 5.—E. Hahnemann, S. Norwalk, Ct., sixty-two years old. Regular simple extraction Nov. 19, 1890. No reaction eleven days, then irido-cyclitis with a small quantity of blood and puriform substance at bottom of anterior chamber. Discharged in seven weeks with S $\frac{1}{300}$. On Feb. 21, 1891, came back, eye much better. S $\frac{15}{300}$. Capsule opaque; split with discission needle Feb. 21, 1891, thirteen weeks after the extraction. No particular reaction the first week, but then the eye grew hard and the sight dim. Relief by eserine. Discharged March 21, 1891, with S $\frac{20}{70}$. Having had several relapses at home, he returned April 20, 1891. Cornea and pupil clear, but iris somewhat bulging and tension increased. The next day I performed an upward iridectomy. The iris, escaping the capsule forceps, was drawn out with a blunt hook. A few drops of aqueous first flowed out, then some vitreous, as usual. Instantaneous relief and prompt recovery. S, May 1, in seven days, $\frac{20}{70}$. On Dec. 9, 1891, eight months, $\frac{20}{30}$. No excavation. Tn.; eye quiet.

The next case is very important, because both eyes had glaucoma after regular extractions, performed at an interval of eight months:

CASE 6.—Lilly M. Lees, thirty-two years old, of Newport, R. I. R. eye cataract of three years' standing, mature, uncomplicated. Functional examination normal. Neither diabetes nor albuminuria. Dec. 6, 1890, simple extraction; operation and recovery normal. Discharged Dec. 15, 1890, *i.e.*, in nine days, with S = $\frac{20}{70}$. Returned Jan. 2, 1891, with S = $\frac{20}{70}$. Discission as usual. Five days without reaction, then acute glaucoma, with intense pain, œdema of lids, chemosis, muddiness of anterior chamber, dulness of pupil, bulging of iris all around its periphery, sight very dim, + T2. Eserine repeatedly instilled brought some relief at first, and in the afternoon the tension was so much less that there was hope of a recovery. In the night, however, the pain returned with greater severity, and the other symptoms were worse than before. On receiving this report in the morning, I went at once to the hospital and made an upward iridectomy at 8.30 A.M. Incision with a lance 2 *mm* behind the corneal section. Clear, viscid vitreous escaped. The iris was drawn out with a Wecker capsule forceps, and cut together with the protruding vitreous, close to the cornea. The eye was kept shut with the ordinary small

pad of corrosive sublimate gauze and absorbent cotton, held by two strips of court plaster. From that moment the pain had left; the recovery was undisturbed. In two days the wound had united, the coloboma was clear, the iris in normal position. Jan. 12th, 5 P.M., four and one-half days after the iridectomy, the patient left the hospital with a clear pupil and good sight, which when tested on April 20, 1891, and again on Sept. 29, 1891, proved to be $\frac{20}{20}$. The patient has had no relapse or other inconvenience from that eye.

CASE 7.—Sept. 16, 1891, Miss Lees, the patient of Case 6, came to have the cataract removed from the other eye. This was done Sept. 17th. Everything normal. Discharged Sept. 29th with a round pupil; no adhesion; S $\frac{20}{30}$. Oct. 23, 1891, the capsule was split, though her sight was $\frac{20}{40}$, and in conscious remembrance of the outbreak of glaucoma in the other eye after the discission. The operation was done without difficulty or accident. In the night violent pain and the other symptoms of a severe attack of acute glaucoma, + T2 diminished to + T1 by eserine and subcutaneous injection of morphine in the temple. Remission in the evening, but return of the symptoms in the night. The next morning the iris pushed forward, pupil hazy, sight dim, chemosis. Iridectomy at 10 A.M. with Tyrell's hook. Escape of vitreous. Immediate relief. No reaction. Discharged Nov. 4, 1891, with S $\frac{15}{XX}$. No relapse.

CASE 8.—Josephine Lory, Elizabeth Home, Harlem, N. Y. City. Extraction Feb. 3, 1891. Normal. Discharged Feb. 13th with S $\frac{20}{200}$. Returned March 9th with S $\frac{20}{30}$. Thin capsule. Split March 10th. Glaucoma the same night. Relieved temporarily by eserine. Relapse the next day. Iridectomy upward with considerable loss of normal vitreous. Immediate relief. Eye remained somewhat red, but free from pain, for ten days. Discharged with S $\frac{20}{40}$; vitreous and new pupil still hazy.

There are two cases to be added in which glaucoma broke out a longer time after the discission.

CASE 9.—Mrs. Mary Tureman, of Chicago, aged about forty-four, had a cataract removed from her left eye Nov. 26, 1890. Normal. S $\frac{20}{30}$. Discission Dec. 20, 1890. Normal. S $\frac{20}{20}$

Oct. 10, 1891, she came and had a cataract removed from the right eye. Normal. Oct. 25th, S $\frac{20}{20}$.

The left eye, operated on a year previously, showed now S $\frac{20}{15}$ a perfectly clear pupil, and iris and interior of eye normal; but near the centre of the scar of the corneal section there was a minute vesicle, the surroundings of which were red at times; then the vesicle broke, and all was right again. This was evidently a small corneal fistula or cyst, which had been noticed before she came to New York for the operation on the second eye and during the recovery from the same. It gave rise to so little inconvenience that nothing was done for it. When she had returned to Chicago, however, it grew more troublesome; there was inflammation, pain, and dimness of sight—in short, glaucomatous attacks—from time to time. Dr. B. Bettman, who treated her, after having tried myotics, etc., performed, on my suggestion, an iridectomy, which cured the disease at once, restoring her sight. No discomfort since.

Case 10.—L. Durocher, Porto Plata, St. Domingo, fifty-eight years old, had a cataract removed from his right eye Jan. 15, 1891. Normal. S $\frac{20}{15}$. Discission Jan. 30, 1891. Normal. Feb. 12, 1891, S $\frac{20}{15}$. April 8, 1891, S $\frac{20}{15}$.

In March of 1892 he came for the operation on the other eye, which was done, and healed without disturbance. On dressing it a week after the extraction I accidentally inspected also the eye previously operated on, and found the cornea hazy, and the pupil crater-shaped, + T1, and the sight dim. On asking him whether he felt no pain in that eye, he said he did feel pain. The eye was not so clear as before. He did not think it to be of importance, and therefore had not drawn my attention to it. I gave him eserine and morphine, but the attack increased, and was so marked the next day that I made an iridectomy outward, the upper part of the iris showing some adhesion to the capsule. A few drops of vitreous were lost. The eye recovered speedily, and regained its clear aspect and good sight in less than a week.

Besides these cases of well-developed acute glaucoma there are three cases in which, with symptoms of irritation (cyclitis), transient increase of tension is noted, but it was controlled by eserine or pilocarpine, and the eyes recovered permamently without an operation. Dr. Pooley's case, quoted above, seems to have been of this nature.

In the foregoing pages lies all my experience on this subject, and I dare say that no case of glaucomatous inflam-

mation has been overlooked. I remember a few cases from previous years which passed under the diagnosis of iridocyclitis, and had a varying course. How often glaucoma complicates extraction of primary and discission of secondary cataract I am unable to tell. Ten cases in six years, or somewhat more than 1 %, shows that this is not a negligible quantity.

As to the pathogenesis of glaucoma under these circumstances, I do not venture on any hypothesis. It is an example of experimental glaucoma in aphakial eyes of man. All the cases in which it occurred, excepting the one with corneal fistula, had no complications, except a few that had non-inflammatory posterior synechiæ where the capsule had been opened. There was no incarceration of iris in the corneal section, or any other abnormity. The occurrence in both eyes of the same patient after a longer interval confirms the supposition that certain persons have a predisposition for glaucoma.

The mode of operating may, perhaps, have favored the outbreak of glaucoma. During the last years I have made the division of the capsule more extensive than I used to do. Instead of splitting the capsule in the shape of of a T, I did it in the shape of a +, making at first a horizontal incision, then passing the knife up before the upper part of the capsule, transfixing this, and cutting it from above down into the horizontal section; then I split the lower half of the section in a similar way from below upward. This method produces unimpeachably clear pupils, and the results of such operations cannot be excelled; they are truly ideal, and remain so, as I have convinced myself by re-examining multitudes of cases, of from one to six years' standing. Yet the occurrence of glaucoma has made me return to the T-shaped discission, and I take care not to enter the blade of the little knife more deeply into the vitreous than is necessary for a sufficient opening in the capsule.

Do these cases of traumatic glaucoma recover without operation? Some do, as Case 3 of our series demonstrates; others do not, as is proven by Case 2.

Does an iridectomy always cure them? It seems it does;

at least the acute cases of which I have recollection and full notes were promptly and permanently cured by it. I have in most cases made the iridectomy upward, with a lance-shaped knife and a blunt hook. The incision was somewhat behind the corneal section and not very broad. Iris forceps, even those with the teeth projecting downward, mostly fail to grasp the iris. It is therefore necessary always to have an iris hook at hand, and best to use it without first trying the forceps.

In all the operations normal vitreous, which partially or, in the recent cases, totally filled the anterior chamber, flowed out. It had no influence on the healing of the wound, for in all cases the relief was immediate, and the recovery prompt, good, and permanent. This experience takes away the dread of the accident. I would, therefore, recommend the performance of an iridectomy whenever myotics do not promptly and satisfactorily relieve the patient. I never forget a little boy who after the third discission of a congenital cataract developed inflammatory glaucoma, which I recognized and judged correctly, but at that time I had not the courage of making an iridectomy, waiting for a recovery without operative interference until it was too late. The iridectomy, too long delayed, cured the inflammation permanently, but did not restore sight.

All these cases of glaucoma after discission bear the same stamp—pain, swelling of lids and conjunctiva, dulness of cornea and pupil, bulging of the periphery of the iris, with pupillary border drawn back—a crater-shaped pupil—increase of tension, impairment of sight, general disturbance, even vomiting.

Will another operation, paracentesis or sclerotomy, cure these cases? I know not. There seemed to me so much responsibility involved in treating such cases, as to make me at once resort to that glaucoma operation which I deem to be the most reliable, iridectomy, and when experience had once demonstrated its efficacy, I have clung to it. Its performance is not difficult, and the piece of iris to be exsected need not be large. The optical conditions are not essentially prejudiced.

Should the occurrence of about 1 *% of glaucoma after discission induce me to modify the method which I have preferred in operating for cataract? Should I lacerate the anterior capsule freely, or try to remove a portion of it, and in order to do this to the best advantage, should I return to the combined method?* I have not the slightest intention to do anything of the kind, as a rule. The longer I practise simple extraction, the more I like it, for the more I have learned how to control its one dark side, prolapse of the iris. Occasionally I make an iridectomy, or remove a piece of capsule, or lacerate the capsule more freely, or remove the lens in its capsule, but I do those procedures only on special indications. The general method for me remains the simple extraction, with peripheric opening and subsequent discission of the capsule, for this method has continued to give me fewer failures and more permanently good results than any other.

AN EXTREME CYLINDRICAL EFFECT FROM A TILTED SPHERICAL LENS.

By E. L. JONES, M.D., Florence, Ala.

In September, 1888, I removed from the left eye of Peter R., aged fifty-three, a hypermature cataract of fifteen years' duration. The healing process was complicated by a prolapse of the iris, drawing the pupil to upper margin of cornea. He then returned to his home, some distance away, and as his condition, physical and financial, was very poor, and he was also somewhat indifferent, he did not return for glasses until November, 1891, when I found the pupil situated as above described, but clear; and without any glass V = $\frac{1}{2}\frac{1}{0}$. Plain sphericals did not improve this much, but with $\frac{1}{1}\frac{1}{0}$ + $\frac{1}{6}^{c}$ ax. V = $\frac{2}{3}\frac{0}{0}$, and with $\frac{1}{1}\frac{1}{5}$ combined with the cylinder he easily reads J 1.

He then produced an old dingy and scratched glass, a + $\frac{1}{6}$, which his children had unearthed in an old field, which he had rudely rimmed with leather and adapted with a handle, and with this he said he had been reading since the extraction. Being requested to show how he did it, he began by removing the glass six inches from his eye, and then rotated it to an angle of 75° from vertical and read J No. 1 as easily as with his proper correction.

While the optical principles here involved have long been known, it is interesting in this case from the extreme effect produced, and from its independent discovery and application by a wholly illiterate person. Any one with a little patience can demonstrate the preceding facts, by putting in trial frames the neutralizing combination (− $\frac{1}{1}\frac{1}{5}$ − $\frac{1}{6}^{c}$ ax. h), and then holding a + $\frac{1}{6}$ the proper distance from the eye,

rotating it to a sufficient degree, and moving the types to the right distance, when J 1 can be easily read.

As having a probable causal relation to his cataract, which was double, I would mention that his general health is very poor, the most noticeable feature being an anchylosis of the cervical vertebræ, or an ossification of the cervical muscles, which are of stony hardness. His face is in a position of outward and downward rotation, and his head is as immovable, by himself or outside force, as if it were of marble. The high degree of astigmatism resulting from the operation is also of interest.

SYSTEMATIC REPORT ON THE PROGRESS OF OPHTHALMOLOGY DURING THE SECOND QUARTER OF THE YEAR 1891.

By ST. BERNHEIMER, Heidelberg; C. HORSTMANN and P. SILEX, Berlin.

WITH THE CO-OPERATION OF

S. M. Burnett, Washington; Dantone, Rome; Hirschmann, Charkow; E. Marckwort, Antwerp; P. v. Mittelstädt, Metz; L. Werner, Dublin; C. H. A. Westhoff, Amsterdam; Schiötz and Ole Bull, Christiania, and Deus, Berlin.

Translated by Dr. F. E. D'Oench, New York.

Sections I.–V. Reviewed by Dr. ST. BERNHEIMER.

I.—GENERAL OPHTHALMOLOGICAL LITERATURE.

TEXT-BOOKS, MONOGRAPHS, TREATISES ON GENERAL, BIBLIOGRAPHICAL, AND HISTORICAL SUBJECTS.

136. St. Bernheimer. The roots of the optic nerves of man. The origin, development, and course of their fibres. Wiesbaden, J. F. Bergmann, 1891.

137. Leber. The development of inflammation and the effect of the injurious influences causing it, viewed in the light of experiments upon the eye. Leipsic, W. Engelmann, 1891.

138. Gowers, W. B. A manual and atlas of medical ophthalmoscopy. Third edition. Edited with the assistance of Marcus Gunn. London, 1890.

139. Manara. Due anni nell' istituto oculistico della R. Università di Roma. Rome, C. Mariani, 1891.

Bernheimer (136) has made a close study of the origin, devel-

opment, and course of the fibres in the roots of the optic nerves of man, his material being sixty tractus optici and their ganglia, obtained from embryos, immature, mature, and hypermature fœtuses (Weigert's hæmatoxylin staining). The book contains an introduction (methods of examination), chapters on the outer and the inner corpus geniculatum, the thalami optici, and the region of the corpora quadrigemina, and concluding remarks. Three colored plates furnish material aid in the comprehension of this difficult subject. He found among other things that the corpus geniculatum laterale is a true original ganglion of the optic nerve, and not merely an interposed ganglion. The inner corpus geniculatum is also an original ganglion, but also furnishes fibres which, passing over, around, and through it, really have their source in a part of the corpus Luys, thalamic end (*v.* the original). The root of the optic nerve discovered by Stilling and having its origin in the nucleus amygdalæ (corp. Luys) was traced farther than ever before and shown in the drawing; it furnishes a large share of the fibres of the optic nerve, if not the largest.

With almost equal exactness the superficial and deep root of the optic thalamus was shown, and long and short fibres were recognized in the latter, of which it could only be said that they differed from all others in their course and in the formation of their medulla (*v.* the original).

The condition of the region of the corpora quadrigemina could be made out with great probability, but not with certainty like that of the others. The superficial roots of the optic nerves coming from the corpora quadrigemina have not been demonstrated, and their existence could be denied. The existence of the deep root from the posterior corpora quadrigemina is most probable, less so that from the anterior.

The existence of a basal optic-nerve ganglion could not be shown, and the opinion is expressed that the so-called ganglia belong to entirely different fibre-areas.

MANARA (139) reports at length upon the eye diseases observed at the Rome clinic from 1888 to 1890 in 2,693 patients (sixty per cent. diseases of the conjunctiva and cornea), and the operations performed (eighty-two extractions, sixty-five iridectomies).

DANTONE.

II.—GENERAL PATHOLOGY, DIAGNOSIS, AND THERAPEUTICS.

140. DESPAGNET. Anophtalmie congénitale. *Soc. franç. d'opht.*, June 6, 1891.

141. FRANKE. Investigations on the disinfection of eye lotions. *v. Graefe's Arch. f. Ophth.*, vol. xxxvii., 2, p. 92.

142. GÜNSBURG. On pseudo-ephedrin. *Virchow's Arch.*, vol. cxxiv., 1.

143. SPIERER, S. Absorption of a piece of bone in the eye. *Zeh. klin. Monatsbl. f. Augenhk.*, vol. xxix., p. 224.

DESPAGNET (140) demonstrated before the Paris Ophthalmological Society a case in which there was microphthalmus of the left and anophthalmus of the right side. In connection with this Gillet de Grandmont reports that in a case of unilateral anophthalmus he performed canthoplasty on account of the narrow palpebral fissure so common in these cases, so that an artificial eye could be inserted. MARCKWORT.

According to the extensive investigations of FRANKE (141) chemical disinfection of eye lotions should in general be preferred to boiling, as the latter does not protect the solutions against the entrance of germs from the air. It is safest to combine both methods. For the purpose of sterilization the following solutions may be used: Sublimate, 1:5,000 and 1:10,000; the oxycyanide of mercury, from 1:1,000 to 1:5,000; resorcin, 1:1,000; carbolic acid, 1:500; four-per-cent boracic acid with 1:1000 carbolic; Panas' solution; thymol as thymol water. It is impossible to obtain an antiseptic effect with the substances examined in the dilution necessary for our purposes. In general the addition of sublimate 1:10,000 is sufficient for atropine and cocaine; such a solution will certainly remain aseptic for half an hour to an hour. For eserine sterilization the addition of sublimate or resorcin is advisable. Atropine conjunctivitis does not occur when sublimate is added. For practical purposes it is sufficient to add for every ten grammes of liquid two drops of a one-per-cent. solution of sublimate.

GÜNSBURG (142) has made extensive experiments on Merck's pseudo-ephedrin. It resembles the alkaloid prepared from ephedra vulg. by Wagai in Tokio. The author thinks that the dilatation of the pupil produced by pseudo-ephedrin is due to excitation of the sympathetic nerve, while there is no paralysis of the terminations of the oculomotor or of the non-striated muscular fibres.

III.—INSTRUMENTS AND REMEDIES.

144. BURNETT, S. M. On the reform in numbering prisms. *Med. News*, May 2, 1891.

145. FISCHER, R. Cure of a case of embolism of the central retinal artery by rubbing the eye. *Deutsche med. Wochenschr.*, 1891, No. 23.

146. GASPARINI e MERCANTI. Sull'azione della linfa di Koch nella tuberculosi oculare sperimentale. *Ann. di ottalm.*, vol. xx., 1–2, p. 128.

147. GUENDE. Un nouveau modèle de seringue pour les injections des voies lacrymales.

148. OSTWALT. Quelques remarques sur l'ophtalmomètre de Javal et de Schiötz. *Rev. génér. d'opht.*, 1891, No. 13, p. 100.

149. OSTWALT. De la force réfringente de la cornée, de l'ophtalmomètre et du cylindre correcteur de l'astigmatisme cornéen. *Rev. génér. d'opht.*, 1891, Nos. 5 and 6, p. 193.

150. PERCIVAL, A. Square prisms and a trial frame adapted for them. *Brit. Med. Jour.*, April, 1891, p. 919.

151. RANDALL, B. A. "Prism-dioptre" *vs.* "centrad" in the reformed numeration of prisms. *Med. News*, April 4, 1891.

152. THOMAS, C. H. Construction and adaptation of spectacle frames. *N. Y. Med. Journ.*, April 4, 1891.

BURNETT (144) advocates the prism-dioptry—that is, a standard prism giving a deflection of one *cm* at one metre distance—as proposed by Prentice, in opposition to the centrad as proposed by Dr. Dennett. BURNETT.

GASPARINI and MERCANTI (146) have made experiments with Koch's lymph upon the eyes of thirty-five rabbits, and have come to the following conclusions: (1) Tuberculin introduced into the conjunctival sac or anterior chamber of a healthy eye causes slight irritation. (2) Injections of lymph into the anterior chamber, when tuberculosis by inoculation has already developed, produce no changes either in the bacilli or in the tubercular tissue. On the contrary, they give rise to inflammatory reaction with exudation and infiltration with leucocytes in the tissue surrounding the tubercles, leading to an aggravation of the primary affection. (3) Injections of tuberculin, made before the development of tuberculosis by inoculation, can neither prevent this nor check the disease in its early stages. The experiments were made and recorded with the greatest exactness, and verified throughout by parallel experiments. DANTONE.

GUENDE (147) has constructed a new syringe for the lachrymal canal, in which the part containing the piston is replaced by a

rubber balloon. The connection with the canula is made without a screw. MARCKWORT.

OSTWALT (148) shows that the results obtained with the ophthalmometer of Javal and Schiötz (model of 1889) are not entirely correct. The true value of the refractive power of the cornea in dioptries is equal to only three fourths of that found with the apparatus; for instance, if 45 D are found, the correct number is 33¾. The astigmatism indicated by the apparatus is also one fourth greater than the real. MARCKWORT.

OSTWALT (149) publishes another paper on the ophthalmometer and comes to the conclusion that the objective test for astigmatism must be supplemented by the subjective, in order to determine the part played by the lens in making up the total astigmatism. MARCKWORT.

PERCIVAL'S (150) prisms are a modification of the Maddox series. As the prisms are square, they can be placed before the eye either vertically or horizontally. WERNER.

RANDALL (151) criticises Burnett's article on the prism-dioptry in the *Ophthalmic Review* for January, and advocates the "centrad" in numbering prisms. BURNETT.

In this paper THOMAS (151) considers the mechanical theory of fitting spectacle-frames, with illustrations. It is instructive and valuable, but no abstract can be made with justice to its merits. BURNETT.

IV.—ANATOMY.

153. MERIAN, KARL. Experimental investigations on the lymph-passages of the eyes.—*Arch. f. Anat u. Physiol.*, anat. part, 1891.

W. His publishes an abstract of the paper prepared twenty years ago by the late KARL MERIAN (153), containing, besides a critical discussion of the literature of the subject, a description of his own numerous experiments. Among other facts he found that the canal through the vitreous (central canal), lately described at length by Stilling has no connection with the lymph-vessels. Neither the canal nor its posterior end (Area Marteg) has any relation to fœtal blood-vessels. The lymph-vessels of the eye are extensively connected with cavities, their contents depend largely upon the varying pressure of very large blood-vessels. This circumstance, as well as the almost complete exclusion from the lymph system of the vegetative part of

the body, proved by numerous experiments, might suggest the thought of separate connections with the circulation of the blood. Escape of the liquid by filtration from the anterior chamber can also be assumed. The arachnoidal space, however, must possess special drains—lymph- or blood-vessels—but it was impossible to demonstrate them.

V.—PHYSIOLOGY.

154. ADLER. The test with colored crayons. A new method of examining for color-blindness. *Wiener klin. Wochenschr.*, 1891, No. 21.

155. FICK. Investigations on the movement of the pigment in the retina of the frog. *v. Graefe's Arch. f. Ophth.*, vol. xxxvii., 2, p. 1.

156. KESSLER, H. M. De perichorioideale ruimte in betrekking tot de Lymphbeweging in het oog. Utrecht, 1891.

157. LANDOLT. Un nouveau cas d'achromatopsie totale. *Arch. d'opht.*, vol. xi., No. 3, p. 202, May.

ADLER (154) uses colored crayons besides the worsteds in testing color-perception. This method has the great advantage that the result with the crayons (oil or pastel) can be permanently preserved on a proper surface.

FICK (155) concludes from a number of experiments that the fact of the movement of the pigment caused by light, as discovered by Czerny, Boll, and Kühne, is certainly correct, but that the outer position is not found in all frogs kept in the dark, and on the whole only rarely occurs in the retina. The greater abundance of pigment in the middle and lower parts of the retina, as well as its greater inclination to occupy the inner position, can be demonstrated on frogs kept in the light or in the dark. The inner position in the illumined eye is not manifested in the other kept in the dark, either by way of the optic nerve or the blood-vessels. This can be shown in frogs whose brains have been removed, optic nerves divided or carotids ligated. This view is contrary to that of Engelmann.

KESSLER (156) finds that in the perichoroidal lymph-space, which is connected by the lacunar tissue of the iris-angle with the anterior chamber and by the perivascular lymph-sheaths of the vortex-veins with Tenon's space, the action of the ciliary muscle is that of a pump, which forces the lymph from the

anterior chamber along the vortex-veins into Tenon's space. The lymph secreted by the ciliary body at once enters the tissue of the zonula, without previously passing through the vitreous. Under normal conditions the liquid flows rather from the anterior chamber than in the reverse direction. WESTHOFF.

LANDOLT (157) reports another case of total color-blindness besides the two already published by him. It is that of a woman of forty-five with nystagmus, whose vision had always been poor, but lately had fallen to $\frac{1}{5}$. Visual field of both eyes somewhat contracted. The papilla pale, the blood-vessels narrow. The color-sense of the parents and children was normal, but one brother was also completely color-blind. All colors produced the sensation of gray in varying shades. Yellow, light-blue, gray, and green appeared brightest; but dark-blue, violet, and grayish-black, which to the healthy seem the darkest colors, appeared brighter than purple-red and the shades of brown, which seemed darkest. The same conditions were found in the two other cases. He regrets that the other observers did not note the vision with greater accuracy, which is of particular value in estimating the nature of color blindness. Poor vision, contraction of the visual field, anæmia of the fundus, conditions which Landolt also observed in his other cases, indicate peripheric location of the congenital defect. v. MITTELSTÄDT.

Sections VI.–XI. Reviewed by PROF. C. HORSTMANN.

VI.—ANOMALIES OF REFRACTION AND ACCOMMODATION.

158. COHN, H. The eyes of the scholars of the Breslau Deaf-Mute Institute. Breslau, 1891.

159. MARTIN, G. De la correction astigmatique. *Ann. d'ocul.*, vol. cv., p. 139.

160. PROSKAUER, TH. A contribution to the statistics of myopia. *v. Graefe's Arch. f. Ophth.*, vol. xxxvii., 2, p. 199.

161. SECONDI, G. Valore di A nel campo di sguardo. *Ann. di ottalm.*, vol. xx., 1–2, p. 104.

162. VALK, F. Astigmatism of low degree. *The Post-Graduate*, April, 1891.

163. WHITE, J. A. Relations of refractive errors and muscular defects in asthenopic or weak eyes, ocular headache, and other reflex neuroses. *Trans. Med. Soc. of Virginia*, 1890.

Among 286 deaf-mute children COHN (158) found 18 with myopia, 45 with hypermetropia, and 196 with emmetropia, while 27 were amblyopic. Among the myopes there were 8 with a congenital high degree of this refractive error. It was worthy of note that the number of near-sighted children did not increase from class to class, nor with advancing age. This is due to the frequent interruption of near-work, to good illumination, properly constructed desks, and the small number of study-hours. Among the 27 cases of amblyopia there were 12 with corneal opacities, but no case of retinitis pigmentosa was observed.

MARTIN (159) defends the theory of astigmatic accommodation. As is well known, the examination with the astigmatometer frequently indicates corneal astigmatism, which the subjective examination with the cylindrical glasses fails to verify. Martin explains this fact by assuming that the ciliary muscle contracts in only one axis, thereby changing the curvature of the lens in only one axis, thus correcting the corneal astigmatism. Tscherning and Bull deny this astigmatic accommodation, and assert that the correction of the astigmatism is brought about by an oblique position of the lens (rotation about its vertical axis). In support of his theory Martin cites the frequent disappearance of the correction after the long-continued use of atropine, and the change in the correction; for the degree of the latter varies during a short period, it decreases or disappears in advancing age and after severe illness, etc. MARCKWORT.

PROSKAUER (160) presents the results of his investigation of 3,216 myopic eyes. He finds that the average visual acuteness of myopes is less than that of emmetropes, and that it steadily decreases with the degree of myopia and the age of the individual. The number of myopic persons diminishes with age. The highest degrees are more frequently found in women than in men. The learned professions and those occupations demanding close application, furnish the greatest percentage of these high degrees. In the low degrees of myopia there is frequently no posterior staphyloma. In 12.3 per cent. of the women and 4.6 per cent. of the men there were chorio-retinal changes at the macula. They were found especially in the highest degrees of myopia and in later life. Opacities of the vitreous were found in 39 cases, detachment of the retina in 23.

VALK (162) finds benefit from correcting an astigmatism as low as 0.25 D. BURNETT.

In eighteen months WHITE (163) has seen in private practice 453 cases of refractive troubles, and 115 cases of muscular defects (heterophoria). Of these latter there was esophoria in 51 cases, exophoria in 34 cases, hyperphoria in 31 cases. He has performed graduated tenotomy 60 times, and resection of a piece of the weak muscles 18 times. No operation was done until all other means had failed, and in all the patients were cured of their asthenopia. BURNETT.

VII.—LIDS.

164. CHANTRE. Étude sur la restauration des paupières. *Thèse de Lyon*, 1891.

165. CHISHOLM, F. M. The eccentric growth of eyelashes. *Amer. Journ. Ophth.*, April, 1891.

166. DENTI. Rinoblefaroplastica col metodo indiano. *Boll. d'ocul.*, vol. xiii., 11–12.

167. GILLET DE GRANDMONT. Nouvelle opération du ptosis congénital. *Rec. d'opht.*, 1891, p. 267.

168. GOULD, G. M. Superciliary entropium. *Med. News*, June 27, 1891.

169. NOVELLI. Di un caso di blefaroplastica della palpebra superiore. *Boll. d'ocul.*, vol. xiii., 7.

170. RAEHLMANN, G. Primary new formation of hairs on the intermarginal edge of the lid as the usual cause of trichiasis. *v. Graefe's Arch. f. Ophth.*, vol. xxxvii., 2, p. 66.

171. WEISS, L. The pathogeny of chalazion. *Zeh. klin. Monatsbl. f. Augenhk.*, vol. xxix., p. 206.

172. WICHERKIEWICZ, B. Sur une nouvelle méthode blépharoplastique. *Rev. génér. d'opht.*, 1891, p. 7.

CHANTRE (164) recommends the formation of lids according to Tripier. For the lower lid a bridge-like flap is taken from the upper, containing skin and orbicularis muscle. By transplanting the muscle, closure of the lower artificial lid is sometimes said to be obtained. In forming the upper lid a similar flap is taken from the forehead above the eyebrows. MARCKWORT.

In CHISHOLM'S (165) two cases an eyelash had grown from the free border of the upper lid into the integument, forming a bluish line about half an inch in length running directly upward.

BURNETT.

DENTI (166) has never seen any noteworthy results from the treatment of epithelioma of the lids with pyoktanin. In a well-developed case, in which the treatment with the chlorate of potassium produced only a temporary scar, he made a radical extirpation of the neoplasm and covered the defect, which included half of both lids and the skin from the inner canthus to the bridge of the nose, with a flap taken from the forehead. Healing proceeded without interruption. The palpebral fissure was formed later, and the reunion of the cut was prevented by introducing a small triangle of skin at its inner end and fastening it with a suture. The palpebral fissure formed in this manner permitted the eye to exercise its functions, and had remained unchanged at the end of a year. DANTONE.

GILLET DE GRANDMONT (167) describes a new operation for ptosis, which might be described as tarso-muscular resection. After the introduction of Snellen's lid clamp, an incision is made through the skin of the lid 2½ *cm* long, 3 to 4 *mm* from the edge and parallel to it; excision of the orbicularis muscle and exposure of the whole tarsus; incision 2 *cm* long through the whole thickness of the tarsus and lid to the clamp, this incision being also parallel to the edge and 2 to 4 *mm* from it. From the ends of this cut a second in shape of a crescent with the convexity upward is made through the tarsus, dividing everything down to the clamp, so that the piece of cartilage lying between these two incisions is removed. The height of the convexity of the second cut depends upon the greater or less effect desired. The two parts of the tarsus are united with three catgut sutures, none are applied to the skin. MARCKWORT.

Under the name of superciliary entropium GOULD (168) designates that condition in which the long hairs of the eyebrows in old people curve down and inward and rub on the eyeball through the palpebral opening. BURNETT.

NOVELLI (169) reports a successful case of blepharoplasty with a flap taken from the temple in extensive ectropium of the upper lid resulting from burns. DANTONE.

Distichiasis or trichiasis respectively is caused according to RAEHLMANN (170) by proliferation of the epithelial stratum, due to long-continued hyperæmia of the blood-vessels of the lid-margin. This proliferation can and frequently does give rise to the new formation of hairs and sebaceous glands, when it has reached a certain degree.

WEISS (171) introduced pieces of freshly removed chalazion into the anterior chamber of rabbits. In not a single case did tuberculosis of the iris develop, and the tissue introduced was soon absorbed. It follows that chalazion is not the result of local tuberculosis, as Tangl has asserted. Deutschmann came to the same conclusions as Weiss.

After removing the upper lid, on account of melano-carcinoma, WICHERKIEWICZ (172) performed blepharoplasty by taking a pedunculated triangular flap with its apex upward from the lower lid, using it to cover the defect. Six days after the operation he completely severed the broad base from the lower lid. In forming the flap he cut through the whole thickness of the lid, taking, therefore, more than the mere skin. MARCKWORT.

VIII.—LACHRYMAL APPARATUS.

173. CHIBRET. Nouvelle série d' ablations de la glande lacrymale palpébrale. *Rev. génér. d'opht.*, 1891, p. 3.

174. FICK, A. E. On tuberculosis of the lachrymal sac. *Correspondenzbl. f. Schweizer Aerzte*, 1891.

175. TERSON, A. Sur la déstruction du sac au thermocautère et son exstirpation totale dans les fistules et tumeurs lacrymales rebelles. *Arch. d'opht.*, vol. xi., 3, p. 224.

CHIBRET (173) reports fourteen cases more of removal of the palpebral lachrymal gland according to de Wecker. In four cases considerable lachrymation persisted, and Chibret therefore tried to increase the effect by touching the insufficiently excised parts with the thermo-cautery. In three of these four cases he obtained a good result in this way, in the fourth no effect whatever was produced. MARCKWORT.

FICK (174) observed in a patient, aged twenty-six, tuberculosis of the lachrymal sac, which at first had the appearance of dacryocystitis. An incision proved it to be tuberculosis. The pre-auricular glands, the lymph glands at the lower jaw, and the neck of the same side were swollen. The lachrymal sac was excised.

TERSON (175) first presents a review of the treatment of chronic affections of the lachrymal passages, especially the fistulas and ectasia of the sac. He recommends the application of the thermo-cautery in all cases of fistula in which the ordinary methods of treatment are insufficient, where the naso-lachrymal

duct is obliterated, in which a constitutional disease exists, or in which an affection of the nasal cavities prevents recovery. Similar treatment should be adopted in cases without fistula in which probing has failed and dilatation of the sac has developed. After extensive incision of the sac under narcosis, and cessation of the hemorrhage, the author introduces a Pacquelin thermo-cautery, bent and ending in an olive according to Panas, and extensively cauterizes the whole inner surface, especially the upper part. The sac is then filled with iodoform gauze, which remains in place for two days. No pain is said to follow, and the symptoms of irritation in the surroundings are very slight. The iodoform pledgets are introduced until the floor is seen to rise. After the healing, complete obliteration is the rule; sometimes it is only partial, and the channels of efflux remain open, while the fistula is cured. The chemical caustics may be used when there is hope of keeping the canal patent. The author reports three cases cured with the cautery and one by extirpation of the sac, and describes the structure of the latter after removal, with illustrations. Extirpation, with or without subsequent cauterizing with the thermo-cautery, is especially indicated when the sac is much distended and closed.

V. MITTELSTÄDT.

IX.—MUSCLES AND NERVES.

176. DERBY, R. H. Successful effort to restore binocular vision by a partial tenotomy of the superior rectus. *N. Y. Med. Rec.*, May 16, 1891.

177. D'OENCH, F. E. A case of traumatic paralysis of the abducent and oculomotor nerves. *N. Y. Med. Rec.*, April 4, 1891.

178. DUNN, J. A case of injury to the left supra-orbital nerve. *N. Y. Med. Jour.*, May 20, 1891.

179. HANSELL, H. F. A clinical study in the diagnosis and treatment of hyperphoria. *Amer. Journ. Med. Sci.*, April, 1891.

180. HOOR, K. The etiology of acquired nystagmus. *Wiener klin. Wochenschr.*, 1891, No. 18.

181. LIEBRECHT. The etiology and prognosis of paralysis of the ocular muscles. *Münchener med. Wochenschr.*, 1891, No. 24.

182. QUINLAN, F. J. A case of convergent squint corrected by Adams' modified operation for deflected septum. *N. Y. Med. Rec.*, May 20, 1891.

183. SIEMERLING, E. On chronic progressive paralysis of the ocular muscles. *Arch. f. Psychiatr.*, vol. xxii., supplement.

184. TAMAGNI. Della paralisi di convergenza. *Ann. di ottalm.*, vol. xx., 1–2, p. 68.

185. WILSON, H. A contribution to the study of the ocular muscles. *Journ. Ophth., Otol., and Laryng.*, April, 1891.

DERBY (176) reports two cases in which he has made a partial tenotomy of the superior rectus for weakness of the inferior, and in both he was successful in restoring binocular vision, and the asthenopia disappeared. BURNETT.

In D'OENCH'S (177) case a boy ran a rib from an umbrella into his right eye near the inner canthus and close to the orbital margin. Movement limited outward and upward. Recovery in about two months. BURNETT.

In DUNN'S (178) case a man was struck with a stone on the left supra-orbital region. The symptoms, referable to the eyes, which developed were diminished visual acuteness ($\frac{18}{40}$), restricted visual fields in both eyes, spasm of accommodation, clonic contraction of the orbicularis of the lower lid. All these symptoms subsided on section of the supra-orbital nerve. It is curious that the same patient suffered from somewhat the same symptoms from an injury to the brow of the other eye, which were also relieved by section of the nerve. BURNETT.

HANSELL (179) concludes from his experience that hyperphoria is a real affection, though it does not always give rise to asthenopia, and that there are reflex phenomena in highly sensitive persons affected with hyperphoria which are not due to it. It does not depend upon errors of refraction. Tenotomy and not prisms, is the treatment, and the tendon should be completely divided. He reports six cases, three of which were treated successfully. BURNETT.

LIEBRECHT (181) reports on seventy cases of paralysis of the ocular muscles which were kept under observation for some time at Schöler's clinic in Berlin. In twenty-one the cause could not be discovered, six were due to syphilis, twenty-five to tabes, seven to general paralysis, and the remainder to various causes.

In QUINLAN'S (182) case a boy with a deviating septum was also affected with converging strabismus. On relief of the trouble in the septum by means of Adams' operation, the squint disappeared. BURNETT.

SIEMERLING (183) has finished and published a paper on progressive paralysis of the ocular muscles, which he found after Westphal's death among his papers. It is based upon eight cases observed clinically, after death, and microscopically. In every one there was paralysis of varying degree of the twelve external muscles of the eyes, and always as an affection accompanying a psychosis. In all, the nuclei of the abducent nerves and the roots had degenerated, in one case only on one side, in many also the nuclei of the trochlearis and their roots. The affection of the nuclei consisted in degeneration of the ganglion-cells, diminution of the number of fibres in the nucleus, with participation of the basal tissue ; hyperæmia and proliferation of the ependyma were not always found. In the cases described the cause of the progressive paralysis was an affection of the nuclei involving also the muscles and nerves, but also of the two latter only, the nuclei being sound, or sclerosing foci in the course of the intramedullary roots of the nerves, the nuclei, muscles, and nerves not being affected. In two of the eight cases the spinal cord was healthy, in three there was sclerosis of the posterior columns, in two there was an affection of both the posterior and lateral columns, in one there was chronic anterior poliomyelitis besides. Chronic progressive ophthalmoplegia is sometimes the precursor or part of an affection of the nervous system, in which sometimes the spinal, sometimes the cerebral, sometimes both groups of symptoms are most prominent. As regards the psychic disturbance, it generally follows the paralysis of the ocular muscles. Although we are familiar with cases of chronic paralysis of these muscles which run their course without any complication on the part of the nervous system and may continue for decades without it, yet it is worthy of note that in scarcely any case in which an autopsy was performed a complicating nervous affection was absent, while many ended in insanity.

According to TAMAGNI (184), asthenopia of convergence with diplopia, which Parinaud has designated as paralysis of convergence, is nothing but concomitant strabismus, in which the eye which is not used for fixation has been unable to suppress its double image. The author comes to this conclusion after careful examination of such a case. DANTONE.

In 114 cases suffering from asthenopia, WILSON (185) found in hypermetropia, lateral orthophoria, just equilibrium in 14 %, vertical orthophoria in 37 %. In myopia the orthophoria was lateral

in 5 %, vertical in 12 %. In emmetropia, lateral 7 %, vertical 7 %. All the rest had heterophoria of some kind. He reports twenty-two operations for hyperphoria by partial tenotomy. Permanent relief in nine, none in five, others doubtful. BURNETT.

X.—ORBIT AND NEIGHBORING CAVITIES.

186. WÜRDEMANN. H. V. Metastatic abscess and cellulitis of the orbit following double suppurating chancroidal buboes of the inguinal region. *Amer. Journ. Ophth.*, May, 1891.

In WÜRDEMANN'S (186) case the orbital abscess was attendant upon suppurating bubo, and an enucleation had to be done finally. BURNETT.

XI.—CONJUNCTIVA, CORNEA, SCLERA, ANTERIOR CHAMBER.

187. CAUDRON. Tumeurs gommeuses de la conjonctive. *Rev. génér. d'opht.*, 1891, No. 4.

188. DE SCHWEINITZ, G. E. A case of persisting hemorrhage from the conjunctiva of a new-born infant following the instillation of a solution of nitrate of silver. *N. Y. Med. Rec.*, April 18, 1891.

189. GREEFF, R. A remarkable case of pseudo-trachomatous inflammation of the eye. *Arch. f. Augenhk.*, vol. xxiv., p. 60.

190. LOPEZ. Granular ophthalmia in the negro. *Sociedad de Estudios Clinicos*, April 17, 1891.

191. RUMSCHEWITSCH. The oncology of the conjunctiva. *Zeh. klin. Monatsbl. f. Augenhk.*, vol. xxix., p. 261.

192. RYERSON, G. S. Extreme cases of pterygium. *N. Y. Med. Rec.*, May 9, 1891.

193. SCOTT, KENNETH. Result of operating in cases of xerosis co-existing with trichiasis. *Oph. Rev.*, 1891, No. 116.

194. SEDAN. Le trachome. *Rec. d'opht.*, 1891, p. 208.

195. SNELL, S. The prevention of ophthalmia neonatorum. *Lancet*, 1891, p. 926.

CAUDRON (187) reports a case of syphilitic gummata of the conjunctiva. They were destroyed with the galvano-cautery. Three months later there was a relapse. A permanent cure was effected by general anti-syphilitic treatment. MARCKWORT.

In the case of DE SCHWEINITZ (188) a solution of nitrate of

silver—20 grs. to ℥ i.—was applied to the healthy conjunctiva of a negro child, after Credé's method, at birth. In eight hours a bloody discharge set in. At the end of the third day the hemorrhage was replaced by a slightly purulent discharge, and a small ulcer developed on the cornea. There was no hemorrhagic diathesis in the family so far as could be learned.

BURNETT.

As a contribution to the question of trachoma, GREEFF (189) reports an interesting case of granular conjunctivitis in a boy aged fourteen. The picture resembled follicular trachoma. Perfect spontaneous recovery. Greeff believes that trachoma and follicular conjunctivitis are quite different diseases, though they may at first present the same clinical symptoms. (Will be translated, K.)

At the meeting of the "Sociedad de Estudios Clinicos," on April 17, 1891, LOPEZ (190) brought up the often discussed subject of the existence or non-existence of trachoma in the negro, with the object of learning the experience of observers in Cuba. After an animated debate, Montalvo and Santos Fernandez agreed with Lopez as to the rarity of the disease. According to the statistics of the two latter, the ratio was 1:2400 and 1:2200.

RUMSCHEWITSCH (191) describes a melanotic sarcoma of the plica semilunaris and an angiosarcoma of the conjunctiva of the lids.

RYERSON (192) reports two cases of pterygium covering the pupil, in which he made a small iridectomy down and out, with great benefit. The pterygia were not removed. BURNETT.

SCOTT (193) finds that remedying the trichiasis greatly improved the xerosis of the conjunctiva and cornea. WERNER.

SEDAN (194) discusses the methods of treating trachoma which have lately been proposed, some of which are old, others new—for instance, the treatment with nitrate of silver, sulphate of copper, washing with sublimate, rubbing the conjunctiva with sublimate, treatment with boracic acid, scraping, etc. Sedan is opposed to all of these, and favors only jiquirity and excision of the retrotarsal fold. MARCKWORT.

SNELL (195) is inclined to believe that careful cleansing of the infant's eyes with plain water, taking care to avoid secondary infection in the bath, may be sufficient to prevent ophthalmia.

WERNER.

196. CAMO, J. L'opération du staphylome. *Arch d'opht.*, vol. xi., 3, p. 365.

197. CZERMAK, W. Further contributions to the knowledge of corneal fistula. *v. Graefe's Arch. f. Ophth.*, vol. xxxvii., 2, p. 58.

198. FERDINAND, G. Treatment of some forms of corneal opacities by rubbing. *Times and Register*, vol. xxii., 22, p. 456.

199. GALEZOWSKI. De la suture de la cornée et de la sclérotique. *Rec. d'opht.*, 1891, 4, p. 262.

200. HIRSCHBERG, J. A case of keratoconus. *Centralbl. f. prakt. Augenhk.*, 1891, p. 245.

201. INOUYE. Peculiar opacity of the cornea. *Centralbl. f. prakt. Augenhk.*, 1891, p. 244.

202. MARLOW, F. W. Two cases of interstitial keratitis occuring in the tertiary stage of acquired syphilis. *N. Y. Med. Journ.*, June 13, 1891.

203. NIEDEN, A. The value of fluorescin staining in treatment with the galvano-cautery. *Centralbl. f. prakt. Augenhk.*, 1891, p. 129.

204. SIMI. Hypopyon-keratitis. *Boll. d'ocul.*, vol xiii., 9.

FERDINAND (198) gently rubs corneal opacities with a rubber eraser every second day. V in one case rose from $\frac{6}{18}$ to $\frac{6}{9}$.

WERNER.

INOUYE (201) describes a case of enormous numbers of punctate opacities of the cornea without pericorneal injection.

MARLOW (202) reports two cases of interstitial keratitis occurring in the tertiary stage of acquired syphilis, one in a man of 39 and the other in a woman of 57. BURNETT.

In the galvano-caustic treatment of corneal affections NIEDEN (203) recommends the use of fluorescin, as with its aid the diseased tissue can easily be distinguished from the healthy.

Under the date of May 2d, the time at which the harvest begins, SIMI (204) discusses hypopyon-keratitis so common then among the Italian laborers in the fields, and cautions physicians not to neglect affections of the lachrymal sac in their patients, as even a slight abrasion of the cornea may lead to purulent infiltration and destruction of the membrane if blennorrhœa of the lachrymal sac exists at the same time. DANTONE.

Sections XII.–XXI. Reviewed by Dr. P. SILEX.

XII.—IRIS.

205. Acosta. The frequency of specific iritis. *Revista de las Clinicas Médicas*, April, 1891.

206. Liebrecht. Gummous iritis in hereditary syphilis. *Zeh. klin. Monatsbl. f. Augenhk.*, vol. xix., p. 184. (Child 7 months old, death).

207. Vossius, A. On iritis with nodular neoplasms resembling tubercles. *Beiträge zur Augenhk.*, No. 2, 1891.

Acosta, (205) found from the statistics of Santos Fernandez, based on 21,000 patients, that gummous iritis forms 4 % of the whole number and 52 % of all cases of iritis. The gumma is the only characteristic symptom, and that is found only in rare cases.

Burnett.

Vossius (207) presents the clinical history of six cases and a bibliography of the subject. Four of his patients were females aged respectively 16, 17, 31, and 39, and two males of 14 and 15. Some of the tumors resembled tubercles, others gummata or syphilitic papules respectively, which affections, however, could be excluded by the clinical course and experiments. In every case the disease developed under the picture of serous iridocyclitis with deposits on Descemet's membrane, opacities of the vitreous and posterior synechiæ. The nodules disappeared after 4 months at the latest. In conclusion he asserts that there is an iritis attended with the development of nodules on a constitutional basis (tuberculosis, syphilis, leprosy), and another form dependent on the pathological condition of the blood (leucæmia, pseudo-leucæmia) and in disturbed nutrition of the body. The connecting link between the constitutional affection and iritis is probably to be found in diseases of the vascular system (walls thickened and showing hyaline degeneration).

XIII.—CHOROID.

208. Grandclément. Uvéite irienne. *Rec. d'opht.*, May, 1891, p. 257.

209. Rolland. La fluxion périodique du cheval. *Rec. d'opht.*, April, 1891, p. 197.

210. Spierer. Absorption of a piece of bone in the eye. *Zeh. klin. Monatsbl. f. Augenhk.*, vol. xxix., p. 224.

211. TAILOR. Terza osservazione di tuberculosi bulbare. *Ann. di ottalm.*, vol. xx., 3, p. 147.

212. TAILOR. Di un sarcoma endoteliale della chorioidea con degenerazione jalina. *Ann. di ottalm.*, vol. xx., 3, p. 240.

213. VALUDE. Origine de la tuberculose du tractus uvéal. Recherches expérimentales. *Arch. d'opht.*, vol. xi., 3, 1891, p. 258.

214. WOOD, H. Formation of bone in the choroid. *Arch. f. Augenhk.*, vol. xxiv., 1, p. 49.

According to GRANDCLÉMENT (208) inflammation of the parenchyma of the iris should be distinguished from that of the uveal layer, just as we distinguish pneumonia from pleurisy. The former inflammation of the iris runs its course without any marked symptoms of irritation, yet it produces posterior synechiæ.

MARCKWORT.

ROLLAND (209) produces further proof for his assertion (*Rec. d'opht.*, 1891, p. 80) that the moon blindness of animals is an iritis. Before purchasing a horse he advises the introduction of a 1 % atropine salve into the eye, in order to recognize remnants of this disease, a few synechiæ or more extensive adhesions, which may be of importance for the prognosis. MARCKWORT.

TAILOR (212) describes at length a neoplasm which had developed in the choroid and retina of the left eye of a girl of 11, had broken through the sclera in its upper outer part and had spread out into a tumor 2 *cm* broad. The diagnosis of intraocular tuberculosis was verified after enucleation with the microscope, the neoplasm proving to consist of a conglomeration of tubercles which were embedded in soft, infiltrated tissue developing from the degenerated normal. No tubercle-bacilli, however, were found. DANTONE.

VALUDE (213) endeavored to produce in rabbits with vaccine-tuberculosis of one eye tuberculosis of the other healthy one by an injury. It did not develop either after contusions or stab-wounds of the uveal tractus, even when the autopsy showed general infection. The latter generally did not manifest itself until after the vaccinated eye had perforated. The eye therefore seems to be protected against tubercular infection from another organ, just as the body is protected against general infection from a tubercular eye. Probably the germs are not transmitted through the blood but through the lymph-vessels. Tuberculosis of the eye generally depends upon external infection.

V. MITTELSTÄDT.

XIV.—GLAUCOMA.

215. COLLINS, E. T. Aniridia and glaucoma. *Ophth. Rev.*, vol. x., p. 101.

216. DUNN, JOHN. A case of hemorrhagic glaucoma ; enucleation ; report of the condition of the ball. *Amer. Journ. Ophth.*, May, 1891.

217. TAILOR. Sull incisione dell' angolo irideo (contribuzione alla cura del glaucoma) ; nota preventiva. *Ann. di ottalm.*, vol. xx., 1–2, p. 117.

COLLINS (215) records three cases of glaucoma in eyes with aniridia, in two of which the absence of the iris was congenital, and in one traumatic. Microscopical examination of one of the congenital cases showed that a rudimentary iris nodule, which was not large enough to be seen through the cornea, was adherent to the posterior surface of the latter. In the traumatic case the most anterior ciliary processes were adherent to the cornea.

WERNER.

DUNN (216) reports a case of hemorrhagic glaucoma where the eye was enucleated. There was much hemorrhage from the stump and it was hard to control. There was hemorrhage in the vitreous, in the choroid, and in the iris. There was evidently a sclerosis of all the intraocular vessels. The other eye was unaffected. BURNETT.

TAILOR (217) describes a new method devised by de Vincentiis for reducing the intraocular pressure, which consists in making an extensive incision of the iris-angle at the lig. pectinatum with a sickle-shaped needle. The instrument, which must be so constructed that after its introduction and during the incision no aqueous can escape, is passed in through the sclera 1½ *mm* from the corneal margin and pushed across to the other side parallel to the iris ; the incision is made in drawing it back. Experiments made on 12 dogs showed beyond a doubt that this little operative procedure reduced the tension, which did not return to the normal until after 2–5 weeks. He then tried it in 8 cases of absolute glaucoma with marked increase of tension. He claims to have obtained a remarkable result : the tension was reduced in every case, in some below the normal ; the symptoms of irritation disappeared. The patients were kept under observation for months ; only one had a relapse. DANTONE.

XV.—SYMPATHETIC OPHTHALMIA.

218. ABADIE. La question de l'ophtalmie sympathique devant la société d'ophtalmologie de Paris. *Ann. d'ocul.*, vol. cv., p. 108.

219. PONCET. Ophtalmie sympathique. *Soc. d'opht. de Paris*, Feb. 3, 1891.

220. TROUSSEAU. Un cas d'ophtalmie sympathique malgré la résection du nerf optique. *Rev. génér. d'opht.*, 1891, No. 3, p. 97.

According to ABADIE (218) the primarily affected eye should only be enucleated, in case sympathetic ophthalmia has developed in the other, if it has been affected so long and so severely that there can be no more hope of restoring vision. If this is not the case, subconjunctival injections of sublimate may be tried.

MARCKWORT.

PONCET (219) examined six eyeballs which had been enucleated on account of sympathetic ophthalmia, but could find no microbes and therefore denies that the disease is caused by the transmigration of germs. The results of all his examinations were negative as regards the presence of parasites in the sympathizing eye. MARCKWORT.

TROUSSEAU (220) publishes a case of sympathetic ophthalmia after resection of the optic nerve. On Dec. 12, 1890, he excised a piece of the optic nerve 4–5 *mm* long, followed by thorough disinfection with sublimate solution (1:2000) in a case of cyclitis of the left eye, painfulness to touch and therefore threatened sympathetic ophthalmia. On March 1st, the latter disease broke out. On March 21st, enucleation was performed, and some coagulated blood and serous liquid were found behind the left eye. The sympathetic ophthalmia disappeared under mercurial treatment. MARCKWORT.

XVI.—VITREOUS.

221. HAAB, C. On pseudo-tumors of the interior of the eye. *Beiträge zur Augenhk.*, No. 2, 1891.

In two of HAAB'S (221) patients extraction had been performed without accident, in the third exenteration of one orbit had been done 5 years previously on account of carcinoma. The picture resembled that of intraocular tumors, but the tension was never increased, and in all three cases the pseudoplasms soon disappeared. He thinks they were not detachments of the

choroid, but cysts at the periphery of the retina, such as are not infrequently observed in later years. He recommends puncture to settle the diagnosis.

XVII.—LENS.

222. DIMMER, F. The correction with glasses in aphakia. *Zeh. klin. Monatsbl. f. Augenhk.*, vol. xxix., p. 111.

223. FULTON, J. F. Treatment of immature cataract. *Amer. Journ. Ophth.*, May, 1891.

224. HARLAN, H. A case of hernia of iris occurring on third day after cataract extraction without iridectomy; hernia replaced; recovery. *Arch. of Ophth.*, vol. xx., 1, p. 81.

225. PARINAUD. Il prolasso dell' iride nella estrazione della cateratta. *Boll. d'ocul.*, vol. xii., 10.

226. SCHNABEL. Remarks on cataract in children. *Oestr. Ung. Centralbl. f. d. Med. Wissensch.*, No. 26, p. 547, 1891.

227. VAN DUYSE. De l'hémorrhagie choroidienne grave dans l'extraction du cristallin cataracté. *Ann. d'ocul.*, vol. cv., p. 112.

228. VENNEMANN. Un cas de lenticône double antérieur. *Ann. d'ocul.*, vol. v., p. 158.

229. WAGENMANN, A. The anatomy of the thin secondary cataract, with remarks on the healing of wounds in Descemet's membrane. *v. Graefe's Arch. f. Ophth.*, vol. xxxvii., 2, p. 21.

DIMMER (222): "It seems proven that when in aphakia a sphero-cylindrical glass is prescribed after the usual form of examination, the glass furnished by the optician over-corrects the eye. This is especially true of lenses of more than 10 D combined with cylinders, and vision may thereby be materially reduced. To obviate this it is advisable to make the refractive determination with a plano-convex spherical glass, which is placed in front of the cylinder in the trial-frame."

FULTON (223) reports the results of 25 extractions of immature cataract without iridectomy, all successful. He makes a large corneal incision and when necessary washes out the corticalis remaining in the anterior chamber with a boric acid solution. He does not favor the methods of hastening the maturation of cataract.

BURNETT.

VAN DUYSE (227) reports some new cases of destructive hemorrhage from the choroid after extraction. In the first (from

the practice of Bribosia) the hemorrhage destroyed both eyes which had been operated on at one sitting. In the second (also Bribosia's) the hemorrhage began on the second day in one eye while the other healed without accident. He also briefly reports two cases from the practice of Coppez. In a very long paper Van Duyse then discusses the causes of these hemorrhages. The principal result, however, seems to be that we do not know them.

MARCKWORT.

VENNEMANN (228) publishes another case of lenticonus. The patient claims to have seen well when she was a child ; with the beginning of menstruation, however, vision diminished. At the age of twenty the patient was first seen. V without correction was R $\frac{5}{60}$, L $\frac{1}{120}$. Convex glasses up to 3.5 D as well as concave glasses from 11 to 22 D improved sight. Focal illumination clearly showed the abnormal projection of the lens into the pupil.

MARCKWORT.

(*To be concluded in the next number.*)

BOOK REVIEWS.

Festschrift zur Feier des Siebenzigsten Geburtstages von Hermann von Helmholtz. Stuttgart, 1891. Published by the German Ophthalmological Society.

Reviewed by Dr. S. M. BURNETT.

It is one of the chief glories of Germany that she honors her great men of science. A recent evidence of this fact is a sumptuous volume issued under the direction of the Heidelberg Congress of Ophthalmologists, to commemorate the natal day of one whose name will be intimately associated with ophthalmological science for all coming time.

This volume contains contributions from pupils and followers of the great scientist in all quarters of the globe, and reflects in every respect credit upon its promoters and authors. It contains eighteen separate papers, some of them accompanied with chromolithographic plates, of great beauty as well as accuracy of representation. Space forbids us to go into an elaborate analysis of all these papers, and we can only outline the general tenor of each. But all will repay a careful study.

I.—*Cases of congenital coloboma of the optic nerve and chorio-retinitis striata.* (Plate I.) By Prof. **Sämisch,** of Bonn, and Drs. **Caspar** and **Krüger.** Besides a consideration of other reported cases of coloboma, two observations are detailed. The case of *chorio-retinitis striata* showed peculiar white string- or band-like formations in the background of the eye, probably caused by a congenital inflammation of the choroid and retina, which has been gradually increasing.

II.—*A case of hemorrhagic disease of the retina.* (Plate II.) By **R. Marcus Gunn.** Hemorrhages near several of the tortuous retinal veins, which are due, the author thinks, to inherited gout.

III.—*Unusual appearances in a case of retinal embolism about thirty hours after its occurrence.* (Plate III.) By **E. Nettleship.** The peculiarities of this picture are some arborescent grayish figures along the vessels which run toward the macula region, and the stagnation of the arterial blood-stream without diminution of the blood-column.

IV.—*Anatomical examination of an eye, blind from embolism of the central artery of the retina.* By **Wm. Manz.** A woman of sixty-five had sudden blindness, with signs of embolism of the central retinal artery. Glaucoma developed not long after, and a sclerotomy was made. The patient died, and the eye was removed twenty-four hours after death and examined. An embolism was found in the artery near the anterior part of the lamina cribrosa. The nerve was very much atrophied. The author thinks that some of the changes found are due to a thrombosis of the vessels secondary to the embolism.

V.—*Some rare ophthalmoscopic pictures.* (Plate IV.) By Prof. **Otto Haab.** 1st. Chronic tuberculosis of the choroid (Fig. 1). 2d. Syphilitic disease of the retinal arteries (Figs. 2–5).

VI.—*Contributions to the ophthalmoscopic diagnosis of changes in the vascular walls of the retina.* (Plate V.) By Dr. **Ed. Meyer.** The author recognizes two kinds of changes. Case 1. Transformation of the whole vascular system of the retina into white bands in a syphilitic, who was also affected with chorio-retinitis in the other eye. Some little vision still remained in the eye, while the chorio-retinitis of the other recovered. 2. A girl with inherited syphilis has somewhat the same appearances of some of the vascular walls in the disk. The other kind of changes were noted in the vascular walls in Bright's retinitis. All are pictured in colored drawings.

VII.—*Contributions to the question of tuberculosis.* (Plate VI.) By Prof. **H. Knapp.** In eighteen colored figures the successive stages of two series of inoculation tuberculosis of the eye are represented, the first series (figs. 1–7) ending in recovery, the second (figs. 8–18) in destruction of the eyes by caseation. The tuberculosis bacillus was found microscopically, according to Koch-Ehrlich's method, in all rabbits, as well as by re-inoculation with pieces gained by iridectomy. For the first series (ending in recovery) the grafts were taken from the eye of a man, enucleated for iris-tuberculosis; for the second series, from the conjunctiva of a girl which had become tuberculous after a sub-

conjunctival squint operation. Her eye recovered completely, but all the eyes inoculated from it perished.

VIII.—*Binocular vision in its relations to strabismus.* By **E. Javal.** This is an elaborate paper, with a number of illustrations, of which we can give only the conclusion that binocular vision is totally in disaccord with the theory of projection ; and the author lays stress upon the existence of identical retinal points, in accordance with the experience of the individual, as playing an important rôle in the act.

IX.—*A case of cornu cutaneum palpebræ superioris.* By the Duke **Carl Theodor,** of Bavaria. With a figure.

X.—*Skiascopy ; its history and practical application.* By Dr. **Chibret.**

XI.—*A theoretical exposition of the process of ophthalmoscopic optometry of Cuignet, or skiascopy.* By Dr. **H. Parent.**

In neither of these papers, which contain nothing specially new, is there any mention made of those in America that have helped to extend the use of the method and facilitate its practical application. Parent suggests the names ophthalmo-skiascopy or ophthalmo-photoscopy for the method.

XII.—*The concomitant occurrence of disseminate choroiditis and hemorrhagic retinitis or retinal hemorrhage in the same eye.* By Prof. **Theo. Leber.** Leber points out a connection which he has observed in some recent cases between hemorrhagic papillo-retinitis and disseminate choroiditis.

XIII.—*The rôle of infection by interior channels, or endo-sepsis, in ophthalmology.* By Prof. **Panas.** Panas shows from some very carefully studied cases that there are certain intra-ocular suppurations which are incontestably due to ento-infection, one of the most frequent causes of which he believes to be thrombosis of the vessels of the uveal tract and retina.

XIV.—*On the determination of the visual acuteness after the operation for cataract.* By Prof. **Gayet,** of Lyons. Gayet discusses the causes of diminished visual acuteness after cataract extraction. He doubts whether the capsule is as much at fault as has been supposed, and cautions against the indiscriminate employment of capsulotomy. He thinks some regular uniform system should be used by all operators in testing, so that results may be fairly compared. Among other things, he notes the exercise of the patient in seeing, a uniform illumination of a certain adopted candle-power, and the accurate measurement of aphakia and astigmatism.

XV.—*Contributions to the physiology of the movements of the eyes.* By **E. Landolt.** From a number of apparently very carefully executed experiments on the movements of the eyes in reading, Landolt concludes that we have not added much to the classical work of Helmholtz.

XVI.—*On the persistence of constantly called-for states of innervation as a factor in the latent and manifest lateral deviations of the eyes; a clinical contribution to the innervation theory of concomitant strabismus.* By **G. A. Berry.** This elaborately wrought out paper is intended to show that the innervation hypothesis of strabismus as advocated by Hansen-Grut is not only consistent with the phenomena of squint, but is sustained by the analogy which exists between squint and normal positions in respect to these innervations. He accepts the assumption, that a great existing tendency to convergence leads, under favorable conditions, to manifest convergent squint; and a feeble tendency to convergence, to manifest divergence.

XVII.—*A note on astigmatic vision, and its dynamic correction.* By **Carlo Raymond.** Raymond shows in this paper how corneal astigmatism, of low degrees particularly, can be neutralized so that the patient can have good vision for objects by a contraction of the ciliary muscles as a whole, bringing each meridian successively and rapidly to have a focus on the retina.[1] He does not think it necessary to call in for an explanation a partial or unequal contraction of the ciliary muscle as contended for by Dobowolsky and some others.

XVIII.—*On the objective determination of refraction, and on the electric ophthalmoscope.* By Prof. Schweigger. This is a plea for the accuracy and for the more extended use of skiascopy, with a description of a method of employing the electric light in the ophthalmoscopic examination direct and indirect.

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[1] Only the principal meredians have foci, the intermediate meridians have none.—H. K.

Obituary.

I. Sir WM. BOWMAN, Bart., F.R.S.,

died March 29, 1892, of pneumonia, at Joldwynds, Dorking, near London. He was born at Nantwich, July 20, 1816. His father was a distinguished naturalist. After his early education, he became a pupil of the Birmingham General Hospital. In 1837 he entered the Medical Department of King's College, and obtained the membership of the Royal College of Surgeons, in 1839. He was appointed demonstrator of anatomy and curator of the museum at King's College. All his literary contributions are original and of lasting value. The earliest are: "The Structure of Voluntary Muscle"; "The Structure and Use of the Malpighian Bodies of the Kidney," an investigation of fundamental importance. In 1847 appeared the first volume of his and Dr. Todd's famous work on the "Physiological Anatomy of Man," the second volume of which appeared eleven years later. In 1848 he was appointed professor of physiology at King's College, which position he resigned in 1855. From 1840 to 1855 he was assistant surgeon, and in 1856 became full surgeon at the College. He was noted for his diagnostic skill and operative excellence. The death of Dalrymple, which occurred soon after, threw the bulk of ophthalmic practice upon Bowman, forcing him, somewhat against his will, to devote his whole time and energy to ophthalmology. His success was complete and unparalleled. His little treatise, "Lectures on the Parts Concerned in the Operations of the Eye," published in 1849, is classical. In 1851 he first published his mode of treating strictures of the tear duct; later, an excellent paper on "Conical Cornea," in which are first mentioned the pupillary shadows, which subsequently have acquired such great importance in the development of retinoscopy. Later he devised

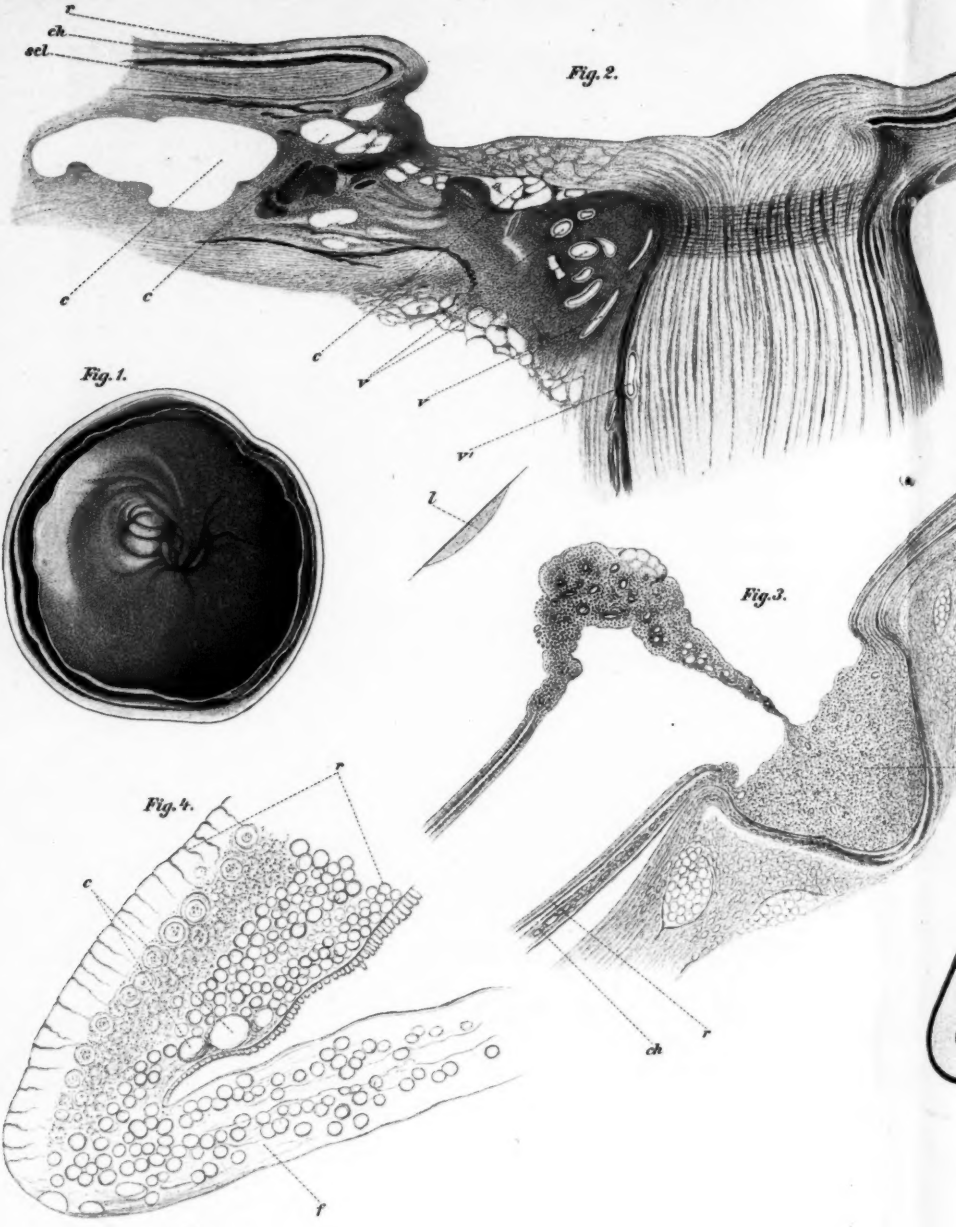
the method of trephining the apex in kerato-conus. Simultaneously with and independently of E. Brücke (who died in 1891) he discovered and described the muscle of accommodation, but never claimed priority for the discovery. He took a great interest in the foundation of the—now flourishing—Ophthalmological Society of the United Kingdom, of which he was made the first president.

More than by his writings, he has served his fellow-men and medical science and art, in particular ophthalmic surgery, by his example and personal teaching. Thousands of young men have received from him most useful knowledge and productive inspiration. His kindness was so genuine, his conduct so gentlemanly, his self-control so complete and constant, and his character so noble, that he had no enemies, but was admired and beloved by every one. His memory will remain sacred to all who knew him, and his name will occupy a permanent position in the history of medical progress.[1] H. K.

II. HASNER VON ARTHA

died Feb. 22, 1892, aged 73. He was professor of ophthalmology at the University of Prague for twenty-eight years, and was distinguished by his energy, industry, originality, and independence. He published a good text-book on eye surgery, and many valuable pamphlets on various subjects of his specialty. He was the most prominent and uncompromising opponent to the brilliant Berlin school under the leadership of A. von Gräfe. Among the few who never adopted v. Gräfe's "modified" cataract extraction he was the most noted, and, before his death, he had the satisfaction of seeing restored to honor Daniel's "simple" extraction, whose champion he had been all his life. Homage to independent conviction and honest work. H. K.

[1] For many of the data of this obituary notice, we are indebted to a very appreciative article on the life of Bowman in *The Lancet* of April 2, 1892.



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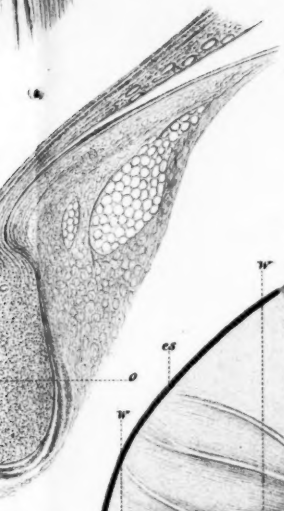

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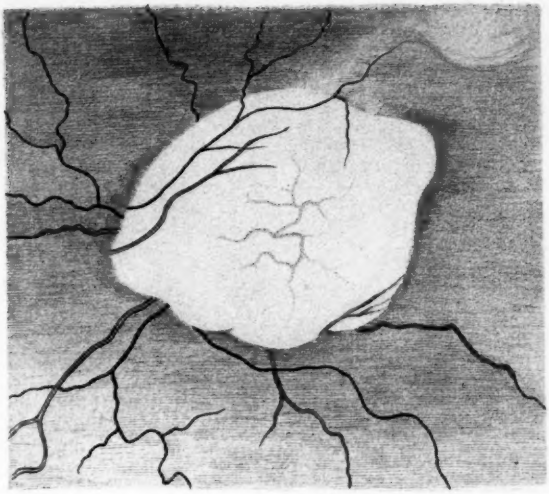

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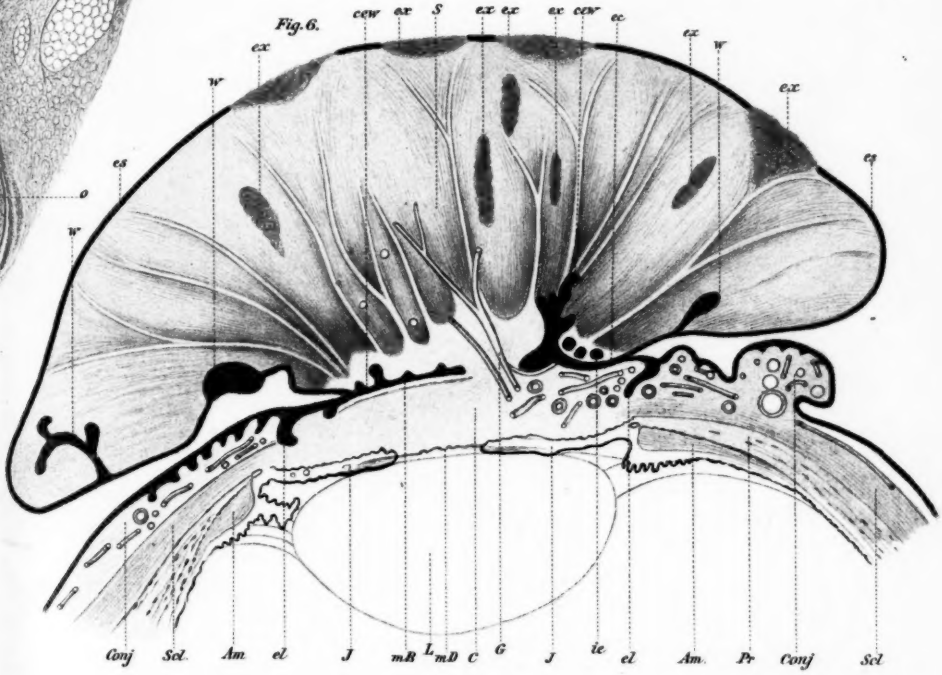
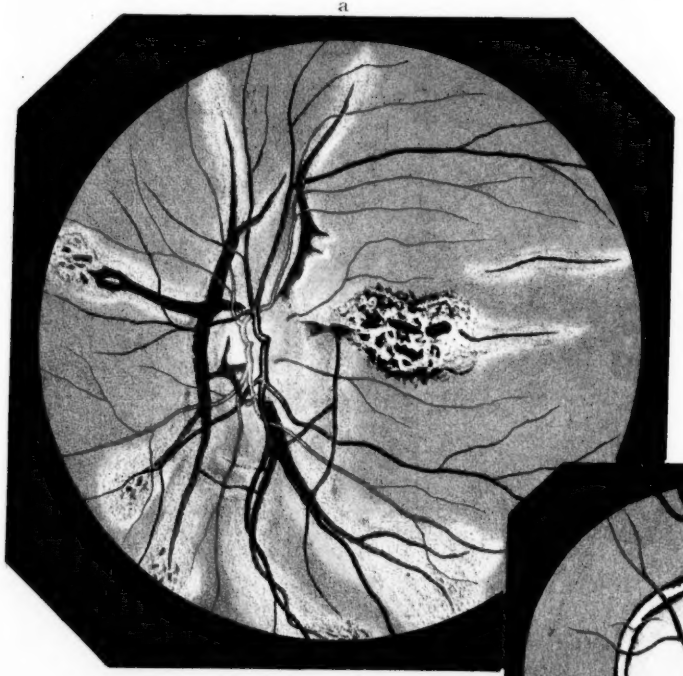


v. J. F. Bergmann, Wiesbaden.

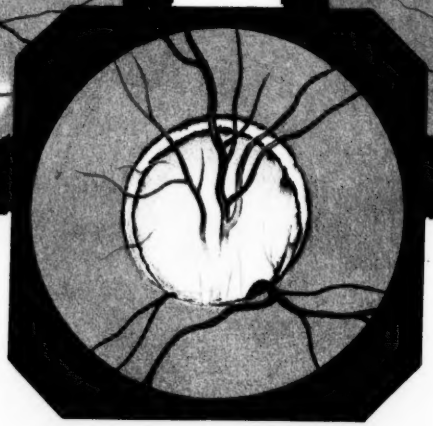
Lith. Anst. v. C. Kürst, Leipzig.

a



Rechtes Auge.
(Umgekehrtes Bild.)

c



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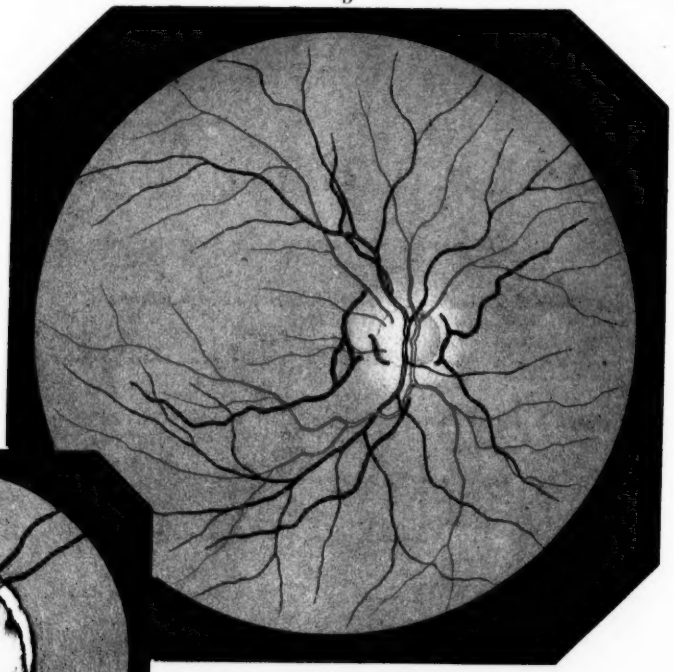

Linkes Auge.
(Umgekehrtes Bild.)

VERLAG VON J. F. BERGMANN IN WIESBADEN

KGL. UNIVERSITÄTSDRUCKEREI VON H. STÜRTZ IN WÜRZBURG.